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VOL. XXXII APRIL, 1934 No. 4

The Society is not responsible, as a body, for the facts and opinions advanced in the papers published by it. Editorials are by the Editor-in-Chief unless otherwise indicated and do not necessarily represent the opinion of the Society as a whole. The "leaders" preceding major articles are to be regarded as editorial additions.

EDITORIAL

THE EMERGENCE OF THE PROFESSION OF FORESTRY IN AMERICA

FORESTRY on this continent is almost ready to burst its chrysalis and emerge as one of the accepted modern professions. But regardless of opinions to the contrary, this event has not yet taken place. There exists at present a large body of men engaged in various lines of activity having to do with forestry, of whom a substantial proportion have received what is intended to be professional training. There are many foresters of professional ability. What is lacking, to bring forth the mature creation, and place the forester on a plane with the doctor, lawyer, or engineer? It is this and this only: that the forester himself shall learn what constitutes the essentials of a profession, and shall make the same distinctions and set up the same fundamental requirements as are demanded of all modern professions.

A profession is a phenomenon of modern civilization, with its development of scientific knowledge. Barbaric tribes practiced crude arts and crafts, based on trial and error, and on inherited knowledge of manual procedure. But the inherent causes of events were a mystery, to cope with which resort was had to superstitions which were rigid and unreasoning. The ancient civilizations were an expansion of these crafts, brought to high excellence, with superstition conveniently retained in medicine, agriculture and other activities, whenever unknown causes threatened to produce unforeseen results. In modern civilization it has for the first time been possible to free mankind from these shackles by resort to scientific investigation of causes, the formulation of theoretical laws, and the application of this new knowledge in the reorganization of practice. A mere glance at the modern developments in medicine or engineering clarifies this conception and emphasizes the distinction between the practices of the medicine man or herb doctor and the modern physician, or the evolution of steel construction, based on pure mathematics and research, in place of bridges built on ancient craftsmen's patterns.

If there is no distinction between the artizan who learned by trial and error guided by inheritance and tradition and the scientist or economist who explores and masters fundamental laws of matter and of human behavior, then there is no such thing as a profession and we have made no advance over the middle ages. The farmer would still follow the tested practices of his ancestors, unmoved by the findings of the agricultural experiment stations and extension specialists. Bac-

teriology in medicine, and modern surgery would be nonexistent. Imported insects and diseases might largely destroy our forest and farm crops.

A profession, as distinguished from a craft, bases its activities upon theoretical understanding of fundamental causes, and thus seeks to predict the results of directed activities. It is clearly recognized by modern professors that a theoretical education is not in itself sufficient, until supplemented extensively with practical experience. The value of the results obtained by practitioners lacking such theoretical instruction is not minimized nor the skill and efficiency of the trained woodsman or administrator belittled, nor is the field of theoretical knowledge confined to those who have received their instruction in institutions. But the distinction exists and wherever a profession has emerged from a craft it is by reason of definite recognition of this distinction, first by the profession itself, and as a consequence, by the public at large.

It is impossible for individuals as such to create a profession. This is accomplished only by united action in the formulation of minimum standards of training and experience, enforced by institutions. In forestry, as in medicine, law and engineering, there are two classes of institutions, the professional school and the professional society. But professional schools may not be adequately conducted to insure these standards. Hence we have surveys and classification of schools, such as were conducted for the medical schools by Dr. Flexner. Based on the recent survey of forest education by Graves and Guise, the Council of the Society of American Foresters is now engaged in the task of classifying the forest schools.

The second step is the clarification of the qualifications for professional membership in the Society itself. This also is under way.

When the Society has by these two measures placed itself in line with other professional societies, it will then be able to carry out its ultimate purpose. This is no less than the protection of the public against individuals posing as professional foresters, who have not the qualifications for such practice, and whose services are therefore apt to lead to failure of attempted measures and loss to their employers and to the public at large.

If there is need for forestry as a profession in America; it there is any reason to hold that the intricate interweaving of physical laws, economic trends and business practice of forestry calls for professional guidance to fully as great an extent as in the more restricted fields of medicine, law or engineering; if the fact is appreciated that in all European countries forestry is recognized not only as a distinct but as one of the most honorable professions; it is then time to come out of the chrysalis of confusion which has tied the hands of the Society and held back the foresters in this country, and has resulted in classifying them, not on a plane with the officers of the army, the doctors, or other recognized professions, but with the timber cruiser, the woods boss; in other words, the craftsman.

It needs no argument to emphasize the fact that foresters have been reluctant to make this distinction and still are. It is not with any desire to draw an invidious class line or to diminish in any way the fraternal feeling which has marked the upward struggle of forestry that we urge the foresters, through the Society, to act. The vital necessity of achieving the goal of permanent establishment of true forest management under the conditions facing us for the future, and the very real danger of an influx both in public and private fields of untrained and inefficient individuals, makes it imperative that as foresters, we establish without delay the solid basis of our profession in America.

H. H. Chapman.

POLITICAL ACTIVITIES IN THE CIVILIAN CONSERVATION CORPS

SECOND REPORT OF COMMITTEE TO NEW ENGLAND SECTION, SOCIETY OF AMERICAN FORESTERS

A PROGRESS report was published in the December JOURNAL OF FORESTRY, page 914, which revealed bad situations in several states, in one instance affecting appointments on national forest camps. The worst conditions always arose when local or county political committees endeavored to dictate appointments. Temporary relief from these crude local tactics was secured through routing all political recommendations through Washington, but there has been increasing insistence by congressmen for recognition of patronage distributed pro rata to these congressmen irrespective of the districts in which camps are located, a demand which has now been conceded by the administration.

Shortly after Mr. Silcox became forester of the U. S. Forest Service he had an understanding with Mr. Farley that no *incompetent* men would be retained under any circumstances in the C.C.C. work. But the principle of selecting for certain supervisory grades only men recommended by politicians remains and is stronger than ever. The task of discovering incompetence in political nominees both after and before appointment is laid upon the foresters in charge. This puts a severe strain on the Forest Service inspectors and state foresters and is an endless performance.

The state forester of Louisiana demanded specific citations of charges that "in the State of Louisiana all appointments to state camps were dictated from the Governor's office with his tacit consent, and political rather than professional efficiency was demanded," and where it is as stated that "the most glaring case of political interference and incompetency was found." The specific charges were therefore sent to the Forest Service in this case on February 5th. The committee may have been in error however in alluding to the Louisiana situation as constituting the "most glaring" case. It has been ascertained that political troubles in Pennsylvania have been more acute than elsewhere. Indiana is also a hotbed of political influences and appointees irrespective of technical status in C.C.C. camps in that state are given the opportunity of joining Democratic clubs the dues of which are a modest payment to politicians of two per cent of the government salary. When Mr. Fechner's attention was called to this situation by O. M. Butler he replied, on February 24th, as follows:

"I thank you for furnishing me with this information and I am today taking it up with the proper authorities in order that a full investigation may be made.

"I want to assure you that the President and everyone else connected with the present Administration is definitely opposed to anything of this kind among the personnel of our C.C.C. camps and vigorous efforts will be made to stamp it out if it has already secured any foothold."

How far this vicious system of party extortion of levies on public salaries has spread is not known by your committee, but it is a natural outgrowth of the principle that a public job is a party job. This levy has been practiced in at least two other states but no definite census of its extent was possible.

If the C.C.C. camps were merely temporary, and had not been continued, the

profession might regard this situation as a passing phase. With the tendency to prolong their existence, the deliberate system of organized political appointments becomes more and more menacing to efficiency in the camps, tending to offset the natural increase in performance records to be expected as a result of experience in camp management and manual dexterity.

Director Fechner has shown a peculiar obtuseness in failure to recognize the existence of a trained professional governmental service composed of foresters, both in federal and state employ, who do not know the meaning of the word politics when charged with the duty of selecting efficient personnel and executing public work. He has refused to credit direct evidence showing that the men appointed by the U. S. Forest Service for camps on national forests were not asked about their politics and that their party affiliations remained unknown to these officers. He made charges that in Montana the Regional Forester has appointed none but Republicans to these camp jobs, a charge since specifically and definitely proved to be untrue, but which he accepted on the statements of three Democratic state politicians. Being fair minded politically he was willing to "split" the appointments between the parties, but the fact that no consideration was given to political affiliations was rejected by him as utterly impossible.

The fundamental defect of the political system of selection of the supervisory force in a public enterprise such as the C.C.C. is this: The original choice of candidates from which exclusive selection must be made is placed in the hands of politicians who are not versed in nor capable of judging the qualifications of the candidates for the work, and is separated from those who are experts in this line. These experts are then required either to accept the nominees or by elaborate investigation prove their inefficiency in advance of their employment. If they reject the entire list, they must then repeat the performance with a new list. They are in no case free to select men known to them as efficient, unless they can first secure political endorsement for the candidate. With the complete adoption of the political system now in force, efforts of state and national foresters to reject inefficient men or remove them after appointment are becoming increasingly obnoxious to the politicians making the nominations. This political pressure acts to break down the resistance of the technical, neutral, trained force to the encroachments of inefficient personnel and the structure begins to give way, always at its weakest points as in states in which the forestry department is under political pressure or domination. The entire system is vicious and absolutely opposed to public welfare and efficiency in the expenditure of public funds.

In an article in the January *Atlantic* magazine, Louis Adamic says, "There is absent from America a trained and neutral civil service. This makes Mr. Roosevelt's administrative problem one of grave magnitude." This writer errs in overlooking the existence of the trained personnel in several governmental departments, but this statement reflects the conditions which will result from the mental attitudes and administrative policies of men like Mr. Fechner and Mr. Farley. It has been the consistent and measurably successful aim of the profession of forestry to create the indispensable trained and neutral civil service, which alone is capable of solving Mr. Roosevelt's administrative problem. The principle of securing "only efficient *Democrats* (or Republicans)" is a fundamental violation of this ideal of a neutral trained civil service and is bound to fail and to undermine the entire structure of government administration of natural resources. The only salvation of govern-

ment in this new era of enlarged responsibilities is in the establishment and stabilizing of a trained, neutral personnel such as has been secured in the U. S. Forest Serivce, and in several of the state forestry departments. The Society of American Foresters cannot for one instant sanction the validity of partizan political appointments as a safe principle for administering the forest resources of nation or states. Its permanent adoption in connection with the C.C.C. camps constitutes a direct attack on the soundness of the entire conservation program of the President.

H. H. Chapman, *Chairman*
Harris A. Reynolds
Philip W. Ayres
A. C. Cline

FURTHER PROGRESS AND ACCOMPLISHMENTS UNDER THE LUMBER CODE

By FRANKLIN REED

Executive Secretary, Society of American Foresters

THE article in the March JOURNAL, pages 275-307, entitled "Conference of Lumber and Timber Products Industries with Public Agencies, on Forest Conservation" is the official report of the Conference's Joint Committee recounting the sequence of events leading up to the two conferences on Article X of the Lumber Code in October and January respectively, the final conclusions and recommendations of the conference and the subsequent activities of the Joint Committee up to the date of going to press, namely, February 12. Since then the following further steps have been taken.

On February 15 the Joint Committee met with Assistant Secretary of Agriculture Tugwell (representing Secretary Wallace, who was out of town) to present the Conference's recommendations. The Joint Committee was accompanied by representatives of the Lumber Code Authority and others who had participated in the conferences. Franklin Reed represented the Society of American Foresters. Henry S. Graves, as Vice-Chairman of the Conference, took the lead in the presentation. John D. Tennant, Chairman of the Lumber Code Authority, and David T. Mason, outlined the recommendations of the Conference in respect to action by the industry which had already been approved by the Lumber Code Authority. F. A. Silcox, chief of the U. S. Forest Service, outlined the recommendations of public action which are to be transmitted to the President with recommendation by the Secretary of Agriculture. Secretary Tugwell expressed gratification at the unexpectedly fine progress that had been made by the Conference and on request of those present, agreed to undertake to arrange a hearing with the President.

On February 23 the President received a delegation composed of the following:

Public Representatives: The Assistant Secretary of Agriculture; F. A. Silcox, U. S. Forester; Earle H. Clapp, and B. P. Kirkland, Assistant U. S. Foresters; Ovid M. Butler, Executive Secretary and G. H. Collingwood, Forester, American Forestry Association; Franklin Reed, Executive Secretary, Society of American Foresters; Ward Shepard, Indian Forest Service, Department of the Interior; W. DuB. Brookings, Chamber of Commerce of the United States; Chester Gray, Washington representative, American Farm Bureau Federation; W. G. Howard, Forester, New York State Conservation Commission; S. S. McCloskey, National Grange; P. S. Ridsdale, American Tree Association; and J. H. Pratt, Chapel Hill, North Carolina.

Industry Representatives: John D. Tennant, Chairman, Lumber Code Authority; B. W. Lakin, McCloud River Lumber Co., McCloud, California; C. R. Johnson, Union Lumber Co., San Francisco, California; G. F. Jewett, Potlatch Forests, Inc., Coeur d'Alene, Idaho; P. V. Eames, Shevlin-Carpenter-Clark Co., Minneapolis, Minnesota; A. Trieschmann, Crossett-Watzek-Gates Co., Chicago, Illinois; W. M. Ritter, W. M. Ritter Lumber Co., Columbus, Ohio, Hardwood Manufacturers Institute; E. R. Plunkett, President, Northeastern Lumbermen's Association,

New York, N. Y.; Wilson Compton, General Manager, National Lumber Manufacturers' Association; C. S. Chapman, Weyerhaeuser Timber Co., Tacoma, Washington; Carl Bahr, Assistant Executive Officer, Lumber Code Authority; W. L. Hall, Secretary, Forest Conservation Conference; H. W. Cole, Little River Lumber Co., California; F. G. Wisner, Eastmann-Goodman Lumber Company, Laurel, Mississippi; G. T. Kirby, New York; Theo. Knappen, National Lumber Manufacturers' Association.

Assistant Secretary Tugwell introduced the speakers to the President. Mr. John D. Tennant, as Chairman of the Lumber Code Authority, told what the industry had undertaken to do in the way of forest conservation. Wilson Compton, General Manager of the National Lumber Manufacturers' Association, emphasized the dependence of the industry program upon the public program, mentioning as essential public projects, complete forest fire protection, reforms in timberland taxation, an institution to provide forest credits and public acquisition direct to certain classes of lands. It was arranged that Assistant Secretary Tugwell and Chief Forester Silcox should confer with the President later as to the details concerning the recommendations for public action.

The President expressed the feeling that "This Conservation Code" is one of the most important undertakings of his administration. He appreciated the difficulties involved in bringing about the general practices of sound forest management and thought that it might take 20 years to attain ultimate success.

On February 26 the National Recovery Administration held a public hearing on the proposed amendment to Article VIII and the proposed supplements to Article X of the Lumber Code which the Lumber Code Authority had approved in accordance with the recommendations of the Article X Conference. William L. Hall presented these proposed changes on behalf of the Lumber Code Authority. He described the manner in which the two sessions of the Article X Conference had been conducted and briefly outlined the conclusions and recommendations arrived at. Brief endorsements of the above mentioned amendments were tendered by C. S. Chapman of the West Coast Lumbermen's Association, A. B. Recknagel of the Northeastern Lumbermen's Association, B. P. Kirkland and W. K. Williams of the U. S. Forest Service; Ovid M. Butler of the American Forestry Association, Franklin Reed of the Society of American Foresters, and Carl W. Bahr, Secretary of the Lumber Code Authority. No opposition to them was expressed.

On February 20 the NRA announced another public hearing to be held on March 12 on certain amendments to the Lumber Code proposed by President Roosevelt himself, and intended to bring under the Lumber Code all forest products industries not now under the Lumber Code or any Code of their own. The announcement in part reads as follows:

"The President has proposed that the Code of Fair Competition for the Lumber and Timber Products Industry be amended as follows:

"In Article II, Section (a), strike out the clause 'and (12) in respect of any Division or Subdivision, additional timber products as enumerated in Schedule "A",' and substitute therefore the following: '(12) such additional timber products as are specifically included in any Division or Subdivision enumerated in Schedule "A"; and (13) all other timber products, including, but without limitation hewn ties, pulp wood, acid wood, mine props, cord wood, and cooperage staves, which are cut for sale or sold, excepting, however, timber products which are cut for sale or sold, and which are specifically

included within any other Code of Fair Competition which has been or may hereafter be approved by the President, or which are exempt by law from the operation of Codes of Fair Competition approved by the President, pursuant to the provisions of Title I of the National Industrial Recovery Act."

Last but not least in importance has been the work of drafting legislation to make effective Conference recommendations. This work has gone on under a special committee headed by Earle H. Clapp. As prepared, the drafts take the form of a general forestry bill which covers most of the Conference proposals. A special bill, however, has been drawn for the Forest Credit Institution and provides for setting up this institution in the Farm Credit Administration. Special legislation is also proposed for dealing with the Oregon and California Land Grant.

On March 12, the NRA hearing mentioned above was held according to schedule, lasting from 10 A.M. to 4:30 P.M. Captain E. A. Selfridge, Deputy Administrator, presided. Representatives of public interests and of the several forest industries affected and of the farm interests testified.

Ovid M. Butler, for the American Forestry Association, endorsed the proposed amendment and emphasized the need, for purposes of efficiency, of having the Article X features of all forest industry codes administered by one agency.

Assistant Forester Earle H. Clapp, for the U. S. Forest Service, endorsed the proposed amendment.

Franklin Reed, for the Society of American Foresters, submitted the following statement:

"Article I of this Code sets forth its declared purposes. One of these purposes is 'to conserve forest resources and bring about the sustained production thereof.'

"Article X prescribes a procedure for accomplishing this purpose,—for writing it into a definite program of specific action and concrete attainment. Much progress, as you know, has already been made in this direction.

"Article II, Section (a) of the Code lists or designates those forest products and forest industries which come under the classification as lumber and timber products industries, which have subscribed to the provisions of the Lumber Code and have undertaken to conserve the forest resources and bring about the sustained production thereof and which are perfecting plans for so managing their forest properties and so conducting their woods operations as to keep their forests continuously productive. This list does not include all of the forest industries. A number of them have as yet no Code of Fair Competition of their own; some may never have a Code and of those that eventually do adopt a Code, some may not include in it a conservation clause (an Article X).

"If it is logical and in the interest of the public and of the industry itself for those forest industries now classified as the Lumber and Timber Products Industries, so to manage their forest properties and so to conduct their logging operations as to conserve their forest resources and bring about the sustained production thereof, it is equally logical and equally in the public and industry interest for those forest industries not now so classified to adopt and carry out the same conservation policies. The intent of the President's proposed amendment to Article II, Section (a) of the Lumber Code is, as I read it, to bring all forest industries, all classes of private forest ownership and all forest operations under the same conservation provisions. Therefore, speaking in behalf of the Society of American Foresters, I desire to give my endorsement to it."

Representatives of the chemical wood industries (namely, those extracting alcohol, acetate of lime, etc., from wood) spoke in favor of a separate code for their industry and against putting their woods opera-

tions under the Lumber Code.

For the mine props industry in the Pennsylvania anthracite fields, representatives of the mine prop producers spoke in favor of the proposed amendment and of putting mine props production under the Lumber Code in order to give their constituents wage and price protection. Representatives of the anthracite mines, the consumers of the props, took the contrary point of view, emphasizing that the anthracite coal mining industry could not stand any additional production costs of any sort.

In the pulp and paper industry there was plainly division of opinion. Representatives of two of the larger pulp and paper companies in Maine, and of pulp and paper interests centering in Cloquet, Minnesota, spoke in favor of the proposed amendment and in favor of putting pulpwood production and operations under the Lumber Code. A group centering around Puget Sound on the West Coast sent in a wire to the same effect. John Hinman of the International Paper Company and president of the recently organized American Pulpwood Association, spoke against putting pulpwood production and operations under the Lumber Code and in favor of putting them under a separate pulpwood code such as recently has been drawn up and submitted to the NRA by the American Pulpwood Association. Hearings by the NRA on this pulpwood code have not yet been held nor a date for them set. Hasty perusal of this pulpwood code indicates that it contains a conservation clause substantially the same as Article X of the Lumber Code, including the proposed supplement to it and the proposed amendment to Article VIII, as outlined on pages 304, 305 and 306 of the March Journal.

Representatives for the American Tie Producers' Association also protested against coming in under the Lumber Code and in favor of a separate code for their industry.

Chester Gray of the American Farm Bureau Federation and Fred Brenckman of the National Grange spoke in behalf of the farmer and his interests. They seemed to be afraid that the farmer would suffer undue injustice if his farm woodlot and the production from it were placed under the Lumber Code;—particularly if he were forced to comply with the code wage scales. Mr. Gray proposed an amendment to the proposed amendment which would exempt from the wage scale requirements any farmer cutting timber of any sort in his farm woodlands who employed not more than two hands. In other words, that timber cutting, wood cutting, or logging on farm woodlands would be considered a commercial enterprise only if done with more than three men.

Those industries or the representatives thereof testifying against the proposed amendment were largely purchasers or consumers of production from farm woodlands; namely, mine props, hewn railroad ties, pulpwood and chemical wood. Possibly they were impelled by two motives: first, they did not want to become the tail to a much larger industry, the lumber industry, by being put under that industry's code; and second, possibly they were afraid that if production from the small timberland owner were put under the Lumber Code whereby advantage could be taken of the price protection features, they would be forced to pay a higher price for their raw material.

Franklin Reed, after giving his testimony for the Society of American Foresters, asked and was granted permission to speak as a farm woodland owner. As the owner of 150 acres more or less of second growth in Vermont, carrying a stand of spruce pulpwood and pine saw logs, he insisted that he was anxious to see the proposed amendment adopted and the administration of Article X of the Lumber Code so conducted and developed as to bring his property and its production under its

control, because by that system only could he see any possibility of selling his products for a high enough price to recover any stumpage value at all or to pay his hands a living wage.

It is to be hoped that before the May Journal goes to press it will be possible to announce action by the Administration on this proposed amendment to Article II of the Lumber Code, as well as the proposed amendment to Article VIII and the supplement to Article X.

Deterioration of the Public Domain

The remaining unreserved Public Domain lands represent an important grazing resource; their deterioration through competitive and unregulated grazing has brought about serious overgrazing which has set in motion several processes of destruction. The range is seriously depleted, the stock industry has suffered from depleted range, lands are being washed away in mountain valleys by accelerated flood flows, and the extensive irrigation development of the west is jeopardized by rapid silting of storage reservoirs. The sensitive balance between conditions of deposition and trenching characteristics of the semi-arid region sets the stage for more headlong and menacing destruction than found elsewhere in the more humid regions. Rehabilitation of the country is dependent upon strict range regulation and artificial works of erosion and flood control.—W. C. Lowdermilk.

WHITHER FORESTRY IN NEW JERSEY?

By HERBERT A. SMITH

Assistant Forester, U. S. Forest Service

IN "Whither Forestry?" the Copeland Report is severely castigated. It is pronounced at the outset to be merely a compound of ill-digested and often conflicting theories, extravagant assertions, and questionable conclusions. "But," magnanimously says the author, "let all that pass; the important query is, is the *National Plan for American Forestry* sound? Is it reasonable? Is it justified?" Precisely. If it is, the kind words do not count for much.

A major ground of criticism is the integration of forestry with land-use planning and policy. Why, it is asked, should forestry assume "*all* the burdens connected with a land policy which, after all is said, is but a reflex of superabundant *wealth*, coupled with the *normal* lack of foresight and of technical skill?" The meaning will be clearer if we substitute for the rhetorical "all," some of; for "wealth," land resources; for "normal," natural, or inevitable.

The association of forestry with public policies intended to bring about the beneficial use of land resources is nothing new. Nor is it a novel thought that abusive land use, resulting in public burdens instead of benefits, is historically explained by abundance of the resource, lack of individual and collective foresight, and faulty practices due to ignorance of better ones. But the implication that consequently land use presents nothing for forestry to be concerned about is decidedly a novel thought.

The whole forestry movement in the United States for the last sixty years has had for one of its major objectives a better adjustment of public policies to the requirements for sound land use. The very essence of forestry is the employment of foresight and technical skill, to make successful use, for forest purposes, of land suited to this form of use; and the chief impulse behind forestry today is public realization of the necessity for better land use. It is this aspect of the forest problem which "Whither Forestry?" would have us turn our backs on at the outset, as beyond our legitimate field of concern.

Range management is "quite remote from . . . forest interest"; the burden of unprofitable farm lands rests elsewhere; water conservation and control problems are primarily for engineers rather than foresters; the remedy for soil losses by erosion is better farming; stream and reservoir silting is too immaterially affected by forest conditions to be in the reckoning. As for forest services and values in such fields as recreational use, wild-life maintenance, and adding to the attractiveness and habitableness of the countryside, they are apparently wholly disdained. Thus the question is narrowed and made solely: Do our future timber requirements justify the proposed "National Plan for American Forestry?"

But this begs the question—sets up a man of straw to belabor. Public forest policy must be shaped with larger objectives in view than merely assuring adequate timber supplies. Of this the forest situation in New Jersey offers illuminating evidence.

New Jersey initiated organized forestry work in 1905. At the outset a policy of state acquisition and administration of forest lands not unlike what had already been inaugurated by the adjoining states of New York and Pennsylvania was ap-

parently contemplated. In 1905 New York owned, in the Adirondack and Catskill Parks, some 1,300,000 acres; Pennsylvania, in her state forests, more than 500,000 acres. These were stimulating examples. The name of the organization created by the New Jersey law of 1905 was, significantly, "The State Board of Forest Park Reservation Commissioners." In both New York and Pennsylvania land use and forest influences rather than provision for meeting future timber needs furnished the strongest arguments for public forest ownership. But New Jersey soon began to develop its forest policy along lines of its own.

The course pursued during the years 1907-1922, the period during which Gaskill was State Forester, gave expression to the same forestry philosophy and creed that underlies "Whither Forestry?" The outstanding feature was sole dependence upon private forestry to bring about right use of the forest resource and right forest conditions. "State ownership in a large way," said the State Forester in his 1915 Report, "is as inadvisable as it is impractical."

To induce private forest management, main reliance was placed on effective state protection against fire, together with educational work, partly in the form of small demonstration forests. For this purpose only was state ownership at first advocated; though after a number of years the growing recreational use of the new state forests which, partly through purchase and partly through gift, had gradually come into existence won the concession that "public outing grounds" should be admitted as a "secondary purpose." It had been maintained earlier that forest recreation would be sufficiently provided for if private owners took up forestry, since the woods were natural playgrounds. As for the game resource, it was held a menace to both forest owners and farm owners; and a policy of deer and rabbit extermination was repeatedly advocated.

But the State Forester of New Jersey was unable to keep entirely free from responsibilities in connection with the state's land policy and the question of land use. In 1915 the "Board of Forest Park Reservation Commissioners" (self-styled from 1907 on simply the Forest Commission) was merged with various other commissions in the newly created Department of Conservation and Development; and Gaskill was elected its Director. Two years later, at the request of the Governor, he prepared a special report on the state's land-use problem. "To the end that the state shall develop socially and industrially as well as agriculturally," it said, "the following statements and recommendations are made." New Jersey had "upwards of a million and a quarter acres of land not now cultivated but capable of producing profitable crops. . . ." Abandoned farm lands comprised 400,000 acres; woodlands suitable for agriculture, 600,000 acres; marsh and swamp, 380,000 acres.

What the state needed was farmers. It should go after them aggressively. The lowest-priced lands, uncleared, "will be sought by pioneers." The light, sandy soils of South Jersey had been more extensively farmed fifty years ago; all that was necessary for them was sufficiently liberal fertilizing. The assessed land values of 27 townships, embracing more than one-fifth of the entire State area, in 7 counties, averaged from \$3.25 to \$9.89 an acre; and one-eighth of all the land in the State seemed to have been left entirely off the assessors' rolls "by reason of its unproductiveness." Rural life should be rebuilt. Only 40 per cent of the upland area of the state was improved farm land.

Two sentences in the "Report of the State Forester" for the same year, to which the special report was attached for publication, are illuminative here. They declared: "As a whole, New Jersey must have less forest rather than more. Our

task is to establish and maintain productive forests on true forest soils and to give over forests that occupy lands available for agriculture."

The conclusion reached in the special report is that through a systematic state effort to encourage farming and obtain farmers, along with a campaign against mosquitoes, it should be possible to increase farm and other property values in the state within 20 years by $900,000,000, yielding the state and its communities "an annual revenue of $13,500,000 more than they now enjoy." In short, here is a land-use plan for New Jersey prepared by the State Forester, which is chiefly directed towards solving the problem of unprofitable farm and forest land. Strikingly conspicuous is the absence of forestry from the picture. In fact, the word is nowhere used in the report. Far from having saddled on it the burden of unprofitable farm lands, forestry seems to have unloaded a considerable land burden on agriculture—600,000 acres of it, to be precise. In the tabulated statements this land is entered as "unproductive land" available for agriculture. The shoe is on the other foot; and the whole attitude of the State Forester towards forestry strongly suggests that of the Michigan boomers who fought to have the tax-reverted lands of that state kept open for disposal to new would-be farmers, as a means of increasing the state's population and supposedly promoting its development.

But the census figures show how inexorably the economic tide swept on, taking more and more of New Jersey's farm land out of agricultural use and laying it for consideration, willy-nilly, at the foresters' doors. For what the plow gives over the forest inevitably reoccupies, sooner or later.

The 1870 census reported in New Jersey nearly 3 million acres in farms, and the 1880 census more than 2 million acres of improved land in farms. From these peaks there was, with one small exception, an uninterrupted decline by decades, accelerated after 1910. The 1920 census showed less than 2.3 million acres in farms, with less than 1.6 million acres improved. The decreases for the preceding decade were respectively 11.3 per cent and 13.7 per cent.

The 1930 census does not continue the record for "improved land in farms." The nearest to an equivalent is the combined "total crop land" and "plowable pasture." In 1929 the total area in farms was less than 1.8 million acres; the combined crop land and plowable pasture, less than 1.2 million acres. In the previous five years these two items decreased respectively 8.7 and 9.6 per cent. The total land area of New Jersey is 4,808,960 acres; only 36.6 per cent was in farms in 1930, as against 62.2 per cent in 1870 and 47.5 per cent in 1920.

The 1930 census reports as the total population of New Jersey 4,041,334 persons; the 1920 census, 3,155,900. But the farm population, exclusive of the small "urban-farm" subclass, numbered only 121,012 in 1930, as against 136,847 in 1920. During the decade the number of farms decreased 14.6 per cent and the average acreage per farm 9.8 per cent.

Urban expansion in part, but only in part, accounts for the persistent and heavy shrinkage in agricultural land use in New Jersey that has been going on since 1870. Of the 21 counties in the state, 14 lie within the territory covered by the so-called regional plans for Greater New York and for the "Tri-State District" centering in Philadelphia and Camden. The latter reaches northward beyond Trenton and southward beyond Wilmington, Del. These two regional plans leave outside their scope only the three westernmost counties in North Jersey, and in South Jersey three washed by the Atlantic and one fronting on Delaware Bay. For these 7 rural counties the record stands; as given in Table 1.

It appears, therefore, that in the three North Jersey counties 59 per cent of the total area was in farms in 1930, and 40 per cent in crop land and plowable pasture, as against 74 per cent in farms and 54 per cent in improved farm land in 1920. In the four South Jersey counties, however, the farm land in 1930 was only 18 per cent of the total area, and the crop land and plowable pasture together only 10 per cent of the total, as against 24 per cent of the total area in farms and 13 per cent in improved farm land in 1920. In the half century preceding 1920 the area in farms declined in the three North Jersey counties 9 per cent, and the improved farm land 15 per cent; in the four South Jersey counties the area in farms declined 29 per cent, but the acreage of improved farm land increased 20 per cent.

It is plain that land has been extensively going out of use for agriculture in North Jersey over a long period, and also that even when agricultural expansion was at its height a substantial part of the North Jersey counties and much the greater part of the South Jersey counties were not only unimproved land but not included in farms at all. Whether or not foresters shut their eyes to the facts, or hold the whole matter none of their concern, here is certainly a very real land-use problem for the people of the state.

Much of North Jersey is occupied by a series of ridges or low mountains, with the Kittatiny Mountains (a northward extension of the Blue Ridge) paralleling the Delaware River and with a central mass which carries a continuation of the rugged Highlands of the Hudson across the state, from northeast to southwest. These wooded hills of North Jersey, with their natural and artificial lakes, form a picturesque and beautiful region, near enough to the metropolitan area of Greater New York to have material public values both as recreation grounds and as sources of water supply. Private estates, country residences, and summer resorts and homes provide other forms of land use. While there are still portions of the region in which the abandoned farm and poor woodland mark the playing out of the old forms of use with little evidence of the oncoming demand for land for other purposes, enhanced prices in most of the region make it certain that a policy of extensive public acquisition solely for commercial timber-growing could not be financially justified. Yet already the

TABLE 1

AGRICULTURAL RECESSION IN 3 NORTH JERSEY AND 4 SOUTH JERSEY COUNTIES, 1870-1930

County group	Total land area—acres	Land in farms—acres						Land not in farms—acres	
		Total			Improved		Crop land and plowable pasture		
		1870	1920	1930	1870	1920	1929	1870	1930
North Jersey	849,920	686,644	624,951	497,381	536,401	455,535	341,742	163,276	352,539
South Jersey	1,264,000	431,862	308,557	232,799	137,728	165,526	128,937	832,138	1,031,201

state holds in North Jersey more than 25,000 acres of forest and park lands; while county park and city watershed ownerships account for an additional 50,000 acres. And the State Board of Conservation and Development published in 1931 a "Program for State Ownership of Park and Forest Land in New Jersey" recommending the acquisition of nearly 70,000 acres more in that part of the state, with an estimated total purchase cost of nearly $2,800,000.

The essence of the North Jersey situation is that the combined recreational and water requirements of the highly industrialized and densely populated part of the region create the dominant public values necessary to recognize in framing a suitable policy of public ownership and use for the region as a whole; that the state must act in the collective interest of all the communities, to assure orderly development and to prevent, for example, appropriation and monopolization of the available water resource by the municipalities earliest in the field or financially best able to acquire control; that the principal of coördinated use to obtain from the forest lands of the region (including the abandoned farm lands and low-value agricultural lands of higher public usefulness for forest than for agricultural purposes) the largest net total of public benefits should be applied, both for working out how extensively public ownership is economically and socially justified and as the governing principle on which to build administrative policy; and that the services of foresters as technicians are necessarily required in properly planning and executing the public task. To conceive of the task of the forester in meeting such a situation as limited to figuring out where he can make commercial timber growing a form of land use that will earn a profit on the capital put in, with compound interest over a long waiting period, and to managing only such enterprises of timber growing as can be undertaken on this basis, is nothing short of grotesque.

The object of forestry is to apply forest management as a means of making land best serve the purposes of the owner, whatever these purposes may be. Where the forester's specialized knowledge and technical skill can contribute to this end, there is professional work to be done. It is open to any forester individually to limit his field of activity as he thinks best for himself; but not so for the profession as a whole. It must either assume the public responsibilities and the duties of public leadership which logically fall within its field or take the consequences of abdication of its responsibilities, in the form of circumscribed influence, diminished opportunities for employment, and loss of public esteem.

In South Jersey the outstanding matter is the breakdown of private forest land ownership as a means of making the land productive. The breakdown is partly masked by the fact that a good deal of the land escapes any taxation at all, and where the ownership is known and taxes are collected the rate is very low. Consequently large-scale reversion to public ownership is not taking place. But protection of the "South Jersey wilderness" from fire as a state function has not brought about the anticipated development of the practice of private forestry. Witness the following sentences from the "Program for State Ownership of Park and Forest land in New Jersey" of the State Board of Conservation and Development:

"In the wilderness areas both the possibility and desirability of large state land ownership stand out . . . the areas are now idle wasteland, degraded by two centuries of neglect and abuse, to a point where most of the land pays little tax and considerable of it none at all. The areas are capable of rehabilitation as productive

woodland but present too unattractive a proposition in this respect to attract private initiative.

"There are more than three quarters of a million acres of such land in the region. . . . There is a considerable part of the whole suitable for agricultural use, but there is no need for a general increase in cleared land in these locations and it is extremely doubtful, from the general agricultural standpoint, whether such development would be wise. It is believed that public ownership of a half million acres of these lands would be good public policy."

In short, the question, "Whither Forestry in New Jersey?" seems on the way to a fairly decisive answer. When State Forester Gaskill assumed office in 1907, not quite 7,500 acres had been acquired for state forests. When he left, in 1922, the state forests and parks contained 17,000 acres. The present area is close to 57,000 acres. The present New Jersey Board of Conservation and Development, however, regards this as only a beginning. It is not unreasonable to expect an eventual public ownership and administration in the entire state of at least 750,000 acres of forest land. The total forest area of the state is still put, as in 1885, at 2 million acres—perhaps an underestimate, in view of the recession of agriculture which has been going on. Quite probably the extension of state ownership which seems in prospect will not be limited entirely to the present forest area but will include more or less land now classed as agricultural. The point is that land use considerations, not the need of public forest management to assure future timber supplies, will provide the major stimulus to state action on behalf of forestry; and the charted course of action is towards public ownership and administration of a very substantial fraction of the forest area of New Jersey. But not, as Brother Gaskill holds, on "the theory that forestry is a cure-all; that in unlimited doses it will banish every ill connected with the land and its product, and make everybody healthy, wealthy and wise;" nor yet on the theory held by Gaskill, that devoting land to forest administration is sound, reasonable, and justified only where and if a safe investment in timber growing can be mathematically made out. No longer is it necessary to rest public policies of forest administration on any theory. These policies are grounded on the very solid and far-extending actualities of land, land-use, and public requirements for products and services obtainable from the land.

SOIL REACTION IN RELATION TO FORESTRY AND ITS DETERMINATION BY SIMPLE TESTS

By S. A. Wilde

Wisconsin Conservation Department

Soil reaction affects the growth of trees by influencing the availability of nutrients, potency of toxic agents, activity of the useful and parasitic soil organisms and physical condition of the soil. A knowledge of soil reaction of the forest nursery and planting sites is, therefore, necessary for the successful growing of seedlings and reforestation. Soil reaction is now easily and quickly determined by means of simple tests, referred to in the paper.

ACIDITY in solution is said to be due to an excess of H-ions over OH-ions; likewise, alkalinity to an excess of OH-ions over H-ions. Pure water contains equal numbers or concentrations of H- and OH-ions, and hence is neutral. When an acid is dissolved in water, it gives rise to H-ions but not to OH-ions; accordingly, there results a greater concentration of H-ions than OH-ions in the solution, thus causing it to become acid. When an alkali is dissolved in water, it gives rise to OH-ions but not to H-ions, and hence there results a greater concentration of OH- than H-ions in the solution, thus causing it to become alkaline.

The concentrations of acidity and alkalinity found in soils and plant and animal tissues are relatively low, and the direct expression of the correspondingly low concentrations of H- and OH-ions in ordinary terms gives rise to fractional values which are inconvenient to express and use. To avoid this inconvenience, the pH scale and method of expression was devised by Sorensen. The symbol "pH" refers to the intensity factor of acidity due to H-ions. The pH value derived under this system is simply the logarithm of the reciprocal of the H-ion concentration, and this value has an integer even for the lowest acidities and alkalinities. For example, suppose the H-ion concentration of a solution is 1/1000 gram per liter, what is the pH of this solution? The reciprocal of 1/1000 is 1000. The logarithm of 1000 is 3. Hence, the pH of this solution is 3. It so happens that the pH value for water is 7, and hence a pH of 7 designates neutrality. Since the pH values are logarithmic functions of the reciprocal of the H-ion concentration, the smaller they are, the greater the H-ion concentration or the acidity.

When the pH values become greater than 7, it follows from the law of mass action that OH-ion concentration becomes greater than the H-ion concentration, and hence the solution becomes alkaline. The greater the value above 7, the greater the alkalinity. For example, a pH of 8 designates an alkalinity which is proportional or equivalent to the acidity at pH 6, and so on.

Whenever there is added to water an acid, or a substance like aluminum sulfate which forms an acid after being added to water, the pH value of the solution becomes less than 7, and the solution is then said to be acid. Similarly, whenever there is added to water an alkali, or a substance like calcium or sodium carbonate which forms an alkali after being added to water, the solution becomes alkaline, and the pH value becomes greater than 7.

The pH scale is thus well adapted for use when dealing with relatively small intensities and quantities of acids and alkalies such as are found in soils, plants, and animals.

Influence of Soil Reaction Upon the Distribution and Growth of Forest Trees

The reaction of the soil affects forest trees either directly through the influence of H- and OH-ions and the balance of acidic and basic constituents, or indirectly by affecting the physical condition of the soil, availability of nutrients, solubility and potency of toxic agents, and activity of the useful and parasitic soil organisms.

Neither mineral nor organic soils more acid than pH 3.7 support normally developed forest stands. The areas of this degree of acidity are, as a rule, covered with the heaths of low shrubs and lichens, or with the bog thickets. The only trees, which may accidentally be found on such areas, are rare superacidophilous species (Scotch pine); however, the occurrence of even these trees is always sporadic and their growth is dwarfed.

The soils of a pH 3.7 to 4.5 are largely correlated with acidophilous conifers (black spruce, tamarack, hemlock, etc.) and with some light demanding deciduous trees (aspen, paper birch). To the majority of other forest trees these, very strongly acid soils are unfavorable, due to toxicity of ferrous iron, manganese, and especially aluminum, which are liberated to a considerable extent as soon as the reaction of a soil is less than pH 4.5.

The strongly acid soils of a pH 4.5 to 5.5 are well adapted to the majority of conifers and many of the deciduous trees with the exception of some of the better hardwoods (white ash, basswood, etc). The low availability of nutrients, viz. nitrate nitrogen, calcium, and phosphates, is the reason for the absence or inferior growth of these latter species on acid soils.

The moderately, or slightly acid soils of a pH 5.5 to 6.9 are characterized by high activity of micro-organisms, energetic humification, high availability of mineral plant nutrients, friable structure and good aeration. In turn, these soils tend to produce high yields of timber, especially of the better hardwood species. However, when the reaction of soil approaches neutrality, certain conifers (Norway spruce) often become subject to fungous diseases.

The alkaline soils of a pH 7.1 to 8.0 support largely the stands of southern hardwoods (oaks, hickory, walnuts, etc.); the majority of other valuable trees, especially conifers, do not grow on alkaline soils, or grow unsatisfactorily. The very fact of the existence within acid forest regions of extensive prairie areas with alkaline soils proves that the forest soil and the acid soil are nearly synonymous. The unfavorable influence of alkaline soils upon the forest trees is due either to toxicity of OH-ions, which are considerably more injurious than H-ions, or to the excess of calcium or magnesium carbonates, causing a lack of available iron (chlorosis), a general disturbance in the assimilation of other nutrients, and often fungous diseases.

The strongly alkaline soils of a pH 8.1 to 8.5 contain an excess of OH-ions as well as those of sodium, chloride, and sulphate, which make the soils of this reaction toxic to all forest trees. Open stands of struggling, dwarf hardwoods, particularly oaks, are nearly the only forest cover here found.

The soils still higher in alkalinity than pH 8.5 are occupied entirely by the lower plants of halophytic nature and are absolutely unproductive sites from the forestry standpoint.

Influence of Soil Reaction upon the Distribution of Ground-cover Vegetation

The reaction of a soil affects not only the distribution and growth of the trees, but also the distribution of the lower, woody and herbaceous plants. Some members of the ground-cover, particularly, show a remarkable correlation with the pH value of the soil, and this helps considerably in practical classifications of forest areas. One of the most striking examples of this relationship is found on heavier drift soils of recent glaciation, confined to the podsol region of this country. In spite of the same geological origin and texture, the soils of this nature (Kennan loam and Kennan fine sandy loam) show an extremely wide range of acidity,—namely, from pH 3.8 to pH 6.8 in the upper portion of the mineral soil of about 6 to 8 inches in thickness. The moderately acid phase of these soils is characterized by reactions of pH 5.5 to 6.5, with extremes of pH 5.0 to 6.8, and supports an association of minimacidophilous plants, such as *Maidenhair fern, sweet Cicely, meadow rue, water-leaf, hog peanut, vetchling* and *leather wood* (Fig. 1a). The strongly acid phase of the same types is characterized by an acidity of pH 4.0 to 5.0 with extremes of pH 3.8 and 5.5, and supports an association of acidophilous plants, such as *Clintonia, club-moss species, wild lily-of-the-valley, bunch berry, partridge berry, twin flower,* and *creeping yew,* (Fig. 1b).

In the studies of forest soils carried on by the Wisconsin State Department of Conservation and the Soils Department of the University, a considerable number of pH determinations have been made in both of the floristic associations discussed. These data are summarized in Fig. 1e, which shows the actual and the theoretical curves for the pH values.

The Significance of Soil Reaction in Reforestation

From a practical standpoint, a knowledge of soil reaction becomes of great importance in reforestation work when the trees are raised from seeds in the nursery, or when young, tender seedlings are transplanted into the field. Under such circumstances, high concentration of either hydrogen or hydroxylions may easily have a detrimental effect upon the germination of seeds, early development of seedlings, and the growth of transplanted seedlings.

This matter is of particular importance because of the fact that the soils of this country on which artificial reforestation is contemplated have all possible grades of reaction. In the region of northern latitude are found extensive areas of strongly acid soils of pH 4.0 and less. On the other hand, all over the forest region occur formations of limestone, dolomitic rocks and the calcareous lacustrine deposits with a reaction as high as pH 8.0. Not seldom, alkalinity of the soil is also brought about by the sedimentation of basic material in areas subject to over-flow, or by energetic hydrolysis that causes the liberation of bases and alkali salts of mineral and organic compounds. It is obvious, therefore, that before selecting an area for a nursery, or planting certain species of trees, one should obtain reliable information in regard to the pH value of the soil.

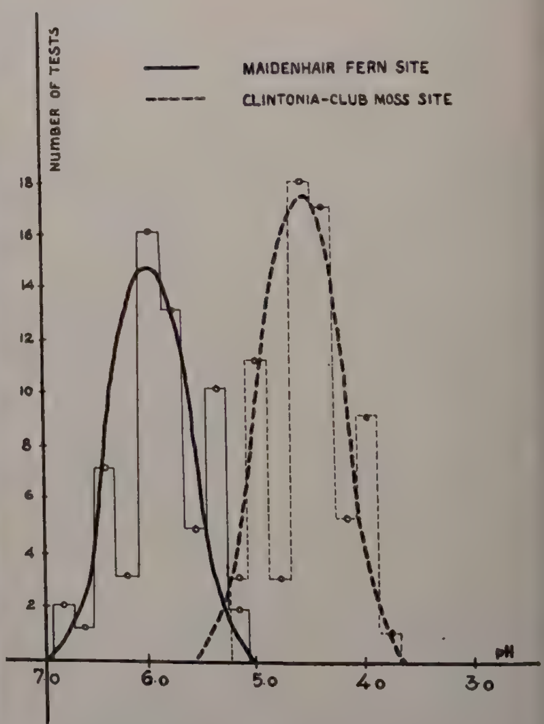
Reaction of Nursery Soil

In nursery practice the reaction of the soil influences not only the growth of seedlings of different species, but at the same time it is a factor which controls development of parasitic soil organisms, the rate and kind of fertilizers that should be applied, and even the amount of watering.

In general, the most desirable reaction

1a. Maidenhair fern site.

1b. Clintonia-Club moss site.



1c. Actual and theoretical frequency curves for the pH values of M fern and Clintonia sites.

Fig. 1.—Floristic appearance of Maidenhair fern and Clintonia-Club moss associations, and their occurrence in relation to pH of soil.

of nursery soil lies between pH 5.0 and 6.0. A reaction less than pH 4.5 is unsatisfactory because of unfavorable influence of toxic soil compounds and low availability of nutrients. A reaction of soil higher than pH 6.5 is highly undesirable in the nursery, since it provides the optimum condition for the development of damping off fungi, eel worms, and other soil parasites that cause the death of seedlings.

Figures 2a and 2b give an idea of how the pH value of a soil may affect in the nursery the germination and early growth of red pine (*Pinus resinosa*) and white spruce (*Picea canadensis*). The sandy soils used in this and similar experiments have usually been buffered with pulverized peat, and their pH adjusted by means of different acidifying and alkalifying reagents, such as nitric and sulphuric acids, aluminum sulphate and calcium carbonate.

Reaction of Planting Sites

The soil is not a homogenous medium as to the pH value, and in many cases the roots of trees may escape the unfavorable influences of extreme reaction by feeding on the less acid or less alkaline portions of soil. Because of this there is a great difference in the influence of pH upon the early growth of trees, depending on whether or not the trees were seeded or planted.

The seedlings originating from natural or artificial seeding grope around in the

Table 1

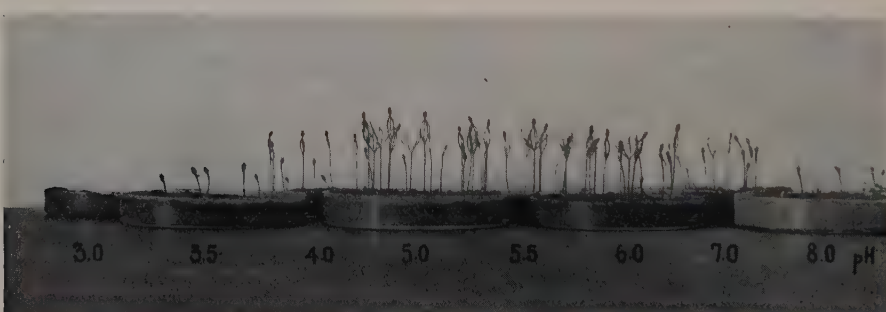
FOREST PLANTING POSSIBILITIES AT VARIOUS pH VALUES AND ASSOCIATED SOIL CONDITIONS

Reaction of soil	pH	Soil conditions	Forest planting possibilities
Extremely acid	Less than 3.7	Non-forest soils; Podsol barrens or acid bogs. High toxicity of soil and unavailability of nutrients.	None.
Very strongly acid	3.7-4.4	Unsatisfactory physical conditions. Possible toxicity due to H-ions and soluble Al. Low availability of nutrients.	Doubtful.
Strongly acid	4.5-5.4	Moderate availability of nutrients, especially CaO, NO_3 and P_2O_5.	Satisfactory for conifers; unsatisfactory for most hardwoods.
Moderately acid	5.5-6.8	Fair availability of nutrients. Usually good physical condition of soil.	Satisfactory for both conifers and hardwoods.
Circumneutral	6.9-7.2	High activity of soil microorganisms both useful and parasitic. Active nitrification and lack of NH_3. Absence of certain symbiotic fungi. Low availability of Fe.	Satisfactory for hardwoods; doubtful for conifers.
Alkaline	7.3-8.0	Unfavorable influence of excessive $CaCO_3$ and $MgCO_3$; lack of Fe. High biological activity.	Satisfactory for some hardwoods; unsatisfactory for conifers.
Strongly alkaline	8.1-8.4	Toxicity of soil due to soluble salts and especially Na_2CO_3. Low availability of certain nutrients. Poor physical condition of soil.	Doubtful.
Very strongly alkaline	8.5 or more	Non-forest soils; solonetz barrens, alkali soils, slick spots. High toxicity of soil and unavailability of certain nutrients.	None.

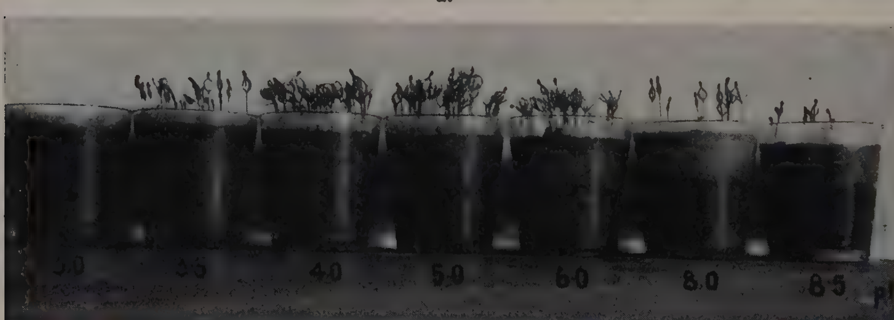
non-homogenous soil and extend their roots into those portions of the soil, which have a suitable reaction. Also, as soon as the seeds germinate, the seedlings gradually develop a certain degree of resistance to unfavorable pH conditions. On the other hand, in planting, the roots of seedlings are placed deeply in the soil; they do not have the opportunity to select the more favorable regions of reaction, but are subjected to whatever extremes of reaction that may exist. Furthermore, planted seedlings have not acquired the resistance to extreme pH conditions as have seeded plants.

The natural reproduction of a species originates by seeding. Therefore, the natural occurrence of a species on a soil of a certain average reaction does not always mean that the same species can be successfully planted on that soil. The only way, then, to assure a success of planting is to plant the species of trees on the soil which has the optimum reaction for that species.

The rule of thumb that may be followed in planting is that the conifers should neither be planted on very strongly acid (less than pH 4.5), nor alkaline soils (more than pH 7.0), whereas the hardwoods on neither strongly acid (less than pH 5.5), nor strongly alkaline soils (more than pH 8.0). There are, indeed, a number of exceptions to this general rule. Yellow birch (*Betula lutea*), for instance, is a hardwood species that does its best on the strongly acid soils, and may survive even on very strongly acid



a.



b.

Fig. 2.—Influence of soil reaction upon the germination and early development of seedlings of Pinus resinosa (a) and Picea canadensis (b).

soils. Hard maple (*Acer saccharum*) may produce a high yield of timber on strongly acid, as well as alkaline soils, whereas, white ash (*Fraxinus americana*) and some southern hardwoods (hickory, walnuts) may not even survive on strongly acid soils. On the other hand, jack pine (*Pinus banksiana*) is a conifer that does fairly satisfactorily on alkaline soils as high in reaction as pH 8.0. White pine, as well as Norway spruce (*Picea excelsa*) may grow satisfactorily within a very wide range of reaction, from pH 4.5 to pH 7.0, and may survive on very strongly acid, or alkaline soils, while red pine (*Pinus resinosa*) has a very narrow, sharply pronounced optimum between pH 5.0 and 6.5, etc.

Table 1 summarizes the relation of reaction of the soil to the general possibilities of forest planting. The knowledge of the specific pH requirement of different species is a matter of local experience, derived from the observations of both the natural distribution of trees and conditions in artificial plantations.

Indirect Influence of Reaction of Nursery Soil

Aside from a direct unfavorable influence of soil reaction, there may be a wide difference between the reaction of a nursery site and that of the area planted, which may cause injury to the root cells and interfere with osmotic action of roots, causing thus an unsatisfactory growth of seedlings. Judging from greenhouse experiments with white pine, Norway pine, white spruce and Norway spruce, a difference of 1.5 pH between nursery and planting site soils seems to be the limit that it is safe to go as regards reaction.

Methods of Determining Soil Reaction and Their Adaptability for Use in Silvicultural Practice

During the past few years, the control of soil reaction of agricultural soils has come into extensive practical use, and a number of methods, or field tests, have been devised for the purpose of a quick determination of pH values. Most of the methods are satisfactory as regards rapidity and simplicity. However, they differ in accuracy and do not always express satisfactorily the reaction of forest soils. An attempt was made to check the results obtainable by the most widely used field tests, and to determine which method is the most satisfactory for practical forestry work. A considerable number of soil samples of typical forest soil horizons have been analyzed, using different field methods. The results obtained have been compared with precise electrometrical determination of hydrogen ion concentration by means of the quinhydrone electrode. The points for and against each method investigated, as they appear from the silvicultural viewpoint, are briefly summarized below:

1. *LaMotte-Morgan test:* Gives satisfactory information. Is better adapted for laboratory than for field work.

2. *LaMotte Soil Teskit:* Results are not always sufficiently accurate.

3. *Hellige Soil Tester:* Results are not always sufficiently accurate.

4. *Soiltex:* Acid range is too limited for forest soils.

5. *Truog soil acidity test:* Using zinc sulfide and lead acetate paper: In cases of acid organic soil layers results may be high.

6. *Rich-or-Poor test:* Test does not give accurately the reaction of organic soil layers and alkaline soils.

7. *Truog soil reaction tester,* using triplex indicator and barite powder: Gives satisfactory information, and is well adapted for field work.

8. *Electrometrical determination:* Gives accurate information. The method re-

quires, however, special laboratory apparatus and considerable experience.

9. *Other methods:* The litmus test, so-called "quantitative methods," the bubbling hydrogen electrode, and a number of other methods for determining soil reaction have not been considered because they are not suited for forestry practice.

It appears, therefore, that the Truog soil reaction tester, using triplex indicator and barite powder, is the most satisfactory method for foresters to use in the field. The following advantages, in particular, make this test well adapted to forestry practice:

(1) The indicator solution is thoroughly mixed with the soil by stirring, so that complete equilibrium between the soil and indicator is established.

(2) The color is revealed by the use of barite powder, which is sprinkled over the soil, and thus interference due to turbidity caused by the soil colloids is eliminated.

(3) The reaction is determined accurately and easily within 0.5 pH, which is adequate for forestry practice.

(4) The testing block contains four cavities, and makes it possible to determine at the same time the reaction of the four different soil layers, that is, of the whole profile of the forest soil.

(5) The complete testing outfit is packed in a small flat case and is thus conveniently carried in the pocket.

CALCIUM AND MAGNESIUM LOSSES FROM CULTIVATION OF FOREST LAND

By JOHN T. AUTEN

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The history of cultivated steep slopes in this country is one of land erosion, exhaustion, and abandonment. As a result, in many regions foresters are confronted with the problem of reclothing abandoned and unproductive lands with trees. Before this can be done successfully, knowledge is needed regarding the adaptability of tree species, especially under the changed soil conditions which follow deforestation and cultivation. The Central States Forest Experiment Station has undertaken a study of the relationships that exist between forest trees and site, one phase of which is reported in this paper.

UNDER forest cover the upper soil horizon was very porous and loose. Roots interpenetrated it; leaf litter decayed and was incorporated in the mineral soil; worms and insects increased the porosity by their burrowing activities; freezing and thawing, expansion and contraction improved its structure. Most of the porosity and looseness was preserved and protected from impact of rain by the cover of leaf litter. Calcium, gathered from the lower levels of soil, was returned to the surface through the leaf litter and increased the flocculation of the surface soil. Altogether there were many processes of nature conducive to increased porosity and looseness of the soil under forests and very few possibilities for compaction. The result was a very loose, porous upper horizon which provided ideal conditions for tree or plant growth, and for the absorption of precipitation. (2)

When the forest cover of trees is removed from such a soil on steep or even moderate slopes, surface run-off and excessive soil erosion commonly occur. The plow destroys the binding power of roots and without protective leaf cover the loose soil particles are easily washed away. Even with the best methods of agriculture, it is difficult to preserve the surface soil on steep slopes. Terracing helps where the soil is deep enough to permit it, but even terracing is not practicable on poor, shallow soil. The results of erosion are everywhere apparent in the hilly regions under cultivation. The seriousness of this loss is evident when it is realized that, according to various estimates, it requires from 400 to 1,000 years to form one inch of soil from rock in place.

Coincident with erosion is loss of plant food through cropping and leaching. This loss is particularly heavy in the case of calcium and magnesium; five hundred pounds per acre per year has been given as an average figure for lime leached from cultivated land. Even soils originally rich in lime soon become deficient and develop an acid reaction. Deprived of the flocculating influence of lime, soil loses its structure and dries out excessively in summer. The subsoil, extensively exposed by erosion, bakes, cracks, and develops a condition very detrimental to the reproduction and growth of forests. It has been found very difficult under such conditions to establish good hardwood growth on impoverished, eroded lands where formerly hardwoods grew well.

The presence of calcium and magnesium is a good indication of the stage of development of a soil. The occurrence of calcium often represents an equilibrium

more or less static between the forces of removal and replacement. This is particularly true of forest soil where the trees gather calcium from lower depths and deposit it on the surface through the leaf litter. When forest soil is cleared and cultivated, the lime gathered for a long period of time by the forest is released and leached downward. The equilibrium is disturbed and the percentage of bases decreases in the surface soil. It was largely to determine these changes that the following study was made. Relative calcium and magnesium contents of forest and adjacent field soils seemed to be a good index of soil changes occurring after the cultivation of cleared forest land.

Historical

No attempt will be made to list all of the voluminous literature on base exchange studies which was reviewed. The works of Gedroitz, Hissink, Kelley, Mattson, Robinson, Bradfield, and others are too well known to those interested in this phase of soil investigation to require a review in this short paper. The analytical methods of Schollenberger and Dreibelbis (5) were followed, with some modifications, in this study.

A considerable amount of work has already been done on the comparison of virgin and cultivated soils. Millar (4) found that virgin soils contained a greater amount of readily soluble materials than did cultivated soils, measured by freezing point method. A decrease in rate of solubility, he says, is one of the important changes a soil undergoes in passing from a virgin to a more or less depleted condition. He found solubility greater in virgin than in cultivated surface soil, but equal in subsoil of both. Ames and Schollenberger (1) found calcium and magnesium content greater in surface soil of virgin sites than in cultivated sites, but the reverse was true of the subsoil. Swanson and Miller (6) found the percentage loss of sulphur from virgin soil through cultivation to be 38.03 and 41.56 per cent respectively for two samples studied. Dunnewald (3) found the calcium content of pine needles from trees grown on limestone soil higher in calcium than that of needles from trees grown in non-calcareous soil.

Experimental

The following experiment was based on a study of seventeen old-growth forests located on a wide variety of soil types in Ohio, Indiana, Michigan, and Illinois. These forests were selected to represent virgin conditions of different forest types with no cutting—except perhaps for the removal of an occasional defective tree—and no evidence of grazing or fire. In addition, a companion site on cultivated land adjacent to each forest site was selected. This cultivated field was, as a rule, just over a fence from the woods. Sampling was done on as near the same levels as possible in woods and field in order to avoid local soil variations.

A composite litter sample was taken in the woods. For the sake of uniformity, the entire organic horizon was sampled down to mineral soil. The mineral soil itself was sampled in three successive horizons, A_1, A_2, and B_1. These depths, while not arbitrary, were comparatively uniform: A_1, from 0″ to 4″; A_2, from 4″ to 12″; B_1, from 12″ to 24″.

The A_1 was the dark colored horizon just beneath the leaf litter zone and was in most forest plots only 2 to 4 inches deep. The A_2 had the same loose, porous structure as the A_1 horizon in a gradually decreasing degree, but did not contain as much organic matter. The B_1 horizon was the zone of accumulation, or what is commonly known as the clay subsoil. In making comparisons of the soil horizons in field and forest, it is well to point out

that in sampling, all field soil was selected to avoid "slick" spots or areas where the subsoil was exposed. Such samples would not have been comparable to the forest soil where the top horizon was still in place.

Table 1 shows milligrams of base exchange calcium and magnesium per 100 grams of soil, replaced by percolation with neutral normal ammonium acetate, in woods and field soil in A_1, A_2, and B_1 horizons.

Table 1 and Figure 1 show clearly the relationships between the amounts of exchangeable calcium in woods and field soil at various depths. Distinctly greater amounts of calcium are shown in woods soil of the A_1 horizon than in the corresponding horizon of the field soil. This difference is very great in many cases. In the A_2 horizons of woods and field soil the relationships are reversed; the field soils with three exceptions have more replaceable calcium than have the forest soils. This may be because cultivation has released calcium from the forest organic matter and it has been leached downward into the A_2 horizon. The same condition exists in perhaps a lesser degree in the B horizon. This has a significant bearing on subsequent reforestation because trees will have bases available at relatively shallow depths. This supply of bases, particularly calcium, will help restore favorable physical structure to the surface soil through the medium of litter decay more quickly than would be the case where a supply of calcium were not so readily available.

The same relationship exists between magnesium in woods and field soil as has been noted for calcium. By referring to Table 1 it may be observed that the A_1 horizon of woods soil contains more magnesium than the A_1 horizon of field soil. In the A_2 and B_1 horizons, as in the case of calcium, the relationship is reversed.

TABLE 1

MILLIGRAM EQUIVALENTS CALCIUM AND MAGNESIUM PER 100 GRAMS OF SOIL IN WOODS AND FIELD BY SCHOLLENBERGER AND DREIBELBIS PERCOLATION METHOD (5)

	Surface or A_1 horizon				Subsurface or A_2 horizon				Subsoil or B_1 horizon			
	Calcium		Magnesium		Calcium		Magnesium		Calcium		Magnesium	
Name	Woods	Field	Woods	Field	Woods	Field	Woods	Field	Woods	Field	Woods	Field
Carnahan Woods	30.9	22.8	7.0	5.4	—	—	—	—	—	—	—	—
Charles Armstrong	10.5	4.8	2.8	.8	1.0	3.7	.5	.9	1.2	5.6	1.8	3.9
Daniel Moser	15.4	1.2	3.3	.4	1.2	2.0	.5	.5	—	—	—	—
State San.	14.4	10.4	1.7	1.0	1.3	2.4	.6	.8	1.8	4.0	2.2	1.8
Keffer Wood	10.2	4.0	1.5	.7	1.4	2.5	.5	.7	3.8	5.6	3.5	2.8
Huston	8.6	6.2	1.4	1.9	8.0	5.6	1.0	1.7	4.8	8.2	3.1	3.4
Ferris	8.0	4.4	1.6	1.3	2.8	3.9	.7	1.2	4.4	4.8	2.8	2.4
Morton	7.2	5.2	1.4	.8	.9	4.4	.3	1.2	1.6	1.6	2.2	3.1
Dillon	12.0	7.6	2.6	.8	4.8	6.0	1.2	1.0	5.4	5.2	3.8	3.5
Myers	18.8	3.6	2.1	1.3	1.9	3.2	.5	1.3	3.0	5.0	4.0	2.4
Reynolds	26.4	10.0	3.5	2.2	4.4	5.6	.6	2.1	2.0	—	—	—
Warren	2.7	1.8	.5	.5	1.3	1.0	.4	.3	—	—	—	—
Pines Park	6.4	4.4	2.1	2.0	5.2	3.4	1.2	1.8	10.0	5.2	5.9	5.5
Bent Tree	6.0	4.8	1.5	2.8	1.3	3.4	.9	2.3	8.8	4.8	.7	4.1
Brownfield	30.0	5.6	3.7	1.5	14.0	6.4	2.3	1.8	6.4	7.2	3.8	2.3
Rhymer	15.6	3.6	2.8	.9	.84	3.6	3.6	.6	4.2	4.8	.3	4.0

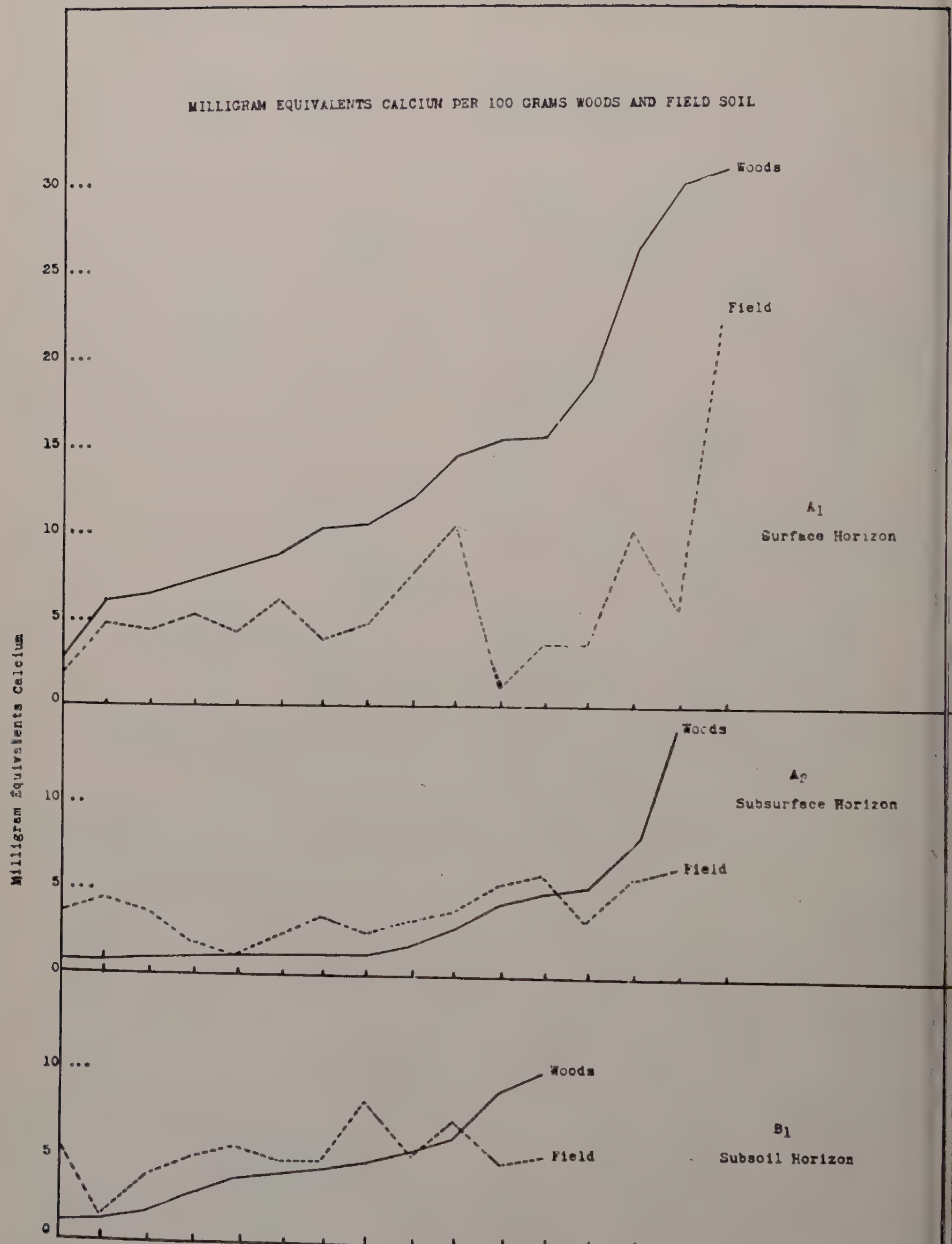

Fig. 1.—For each horizon the order of the forest sites was arranged so that the milligram equivalents of calcium could be drawn as an ascending curve. The corresponding data for the field sites were then plotted to provide a readily visualized comparison.

In terms of percentages, the A_1 horizon of field soil has lost over 50 per cent of the calcium which it had as a woods soil. The A_2 soil horizon of the field has gained 11 per cent over the amount it had under forest conditions. Similar losses and gains are found likewise in the case of magnesium. These figures are based on the assumption that the field soils when formerly forested were identical with the soils of the present woods. In making comparisons of horizons as to loss of bases, it should be kept in mind that the A_1 horizon is comparatively thin (not over 4 inches), whereas the A_2 horizon is, as an average, three times as thick. The difference in volume is very significant when percentages are considered. A small percentage gain in the thick A_2 horizon represents a greater total weight of calcium than the same percentage on the much smaller volume of the A_1.

Another significant fact lies in the location of the virgin sites. The very few old-growth woods remaining in the Central States are on better than average soil. Most of them remain today because the owner was financially able to preserve them for sentimental reasons; and financially able farmers occupy the better soils. Likewise the adjacent field soils show less deterioration by comparison than those of poorer sites. No virgin woods are found in the abandoned land region. Were it possible to make a comparative study of such soils, far greater differences than those reported in this paper would be recorded.

Summary and Discussion

Losses of surface soil following clearing and cultivation of forest land result from erosion and from leaching. Erosion loss is especially great because of the removal of organic matter, plant food and essential elements accumulated in a comparatively thin, loose layer near the soil surface. The processes of cultivation increase the loss of soluble elements through leaching. Cultivation induces rapid oxidation of organic matter, and the carbon dioxide liberated by oxidation hastens the leaching of calcium, magnesium, and other soluble elements.

These destructive processes reduce the fertility, porosity and looseness of the surface soil, decrease its ability to absorb water, and make for conditions adverse to plant growth. The establishment of tree reproduction, either natural or by planting, is rendered more difficult because of this condition. The more valuable hardwood species which may once have grown well on the same hillside, are especially sensitive to these changed conditions.

The loss of calcium and magnesium bases from the surface soil contributes directly to these adverse conditions. A soil deficient in lime loses its granular structure, and tends to bake and crack from dessication during hot, dry periods. Fortunately, as shown by this study, much of the calcium leached from the surface of cultivated forest soils has been absorbed in the horizons just below the surface. When such an area is reforested, the tree roots should be able to use this lime, and bring it to the surface again through its litter. As a litter cover develops, the favorable soil conditions of the virgin forest will be gradually restored (2).

The loss of bases is followed by significant differences in physical properties of the surface soil. These differences in turn greatly inhibit reforestation by desirable species and necessitate changes in silvicultural practices. Where soil exhaustion has continued to the point where hardwoods cannot become established successfully, it may be necessary to grow a crop of coniferous trees first to prepare

the site for subsequent crops of hardwoods.

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PERIODIC LAND USE STUDIES FOR MORE EFFECTIVE PLANNING

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A good many land use studies have been made since 1920. In most cases no specific constructive planning has followed and year by year the value of their results decreases because of changes in land utilization, ownership, etc. In even those few cases where action has been taken new problems crop up requiring readjustments in the plan. Planning activity would be greatly stimulated if the conclusions arrived at in the original studies could be tested, and definite trends in ownership, etc., established by means of periodic investigations. The results of the re-survey of Menominee County, Michigan are presented as an example of how practicable and economical follow-up studies can be.

THE effectiveness of land planning would be materially enhanced if the studies upon which are based the forecasts of trends and the suggested rearrangement of land uses in a given area could be repeated.

Economic relationships in particular, subject as they are to continuous fluctuation, are better understood when the time element is introduced as a factor in their analysis. Comparative agricultural and tax delinquency statistics, ordinarily a part of the land use study, are indeed helpful in indicating trends in ownership and utilization, but they fail to bring out in an adequate manner the shifts over a period from one ownership to another, including the former status of lands already reverted to the state or county.

Obviously, the longer the period between studies, within limits, the better the prospects of establishing definite relationships and trends. However, as is shown below, even so short a period as eight years is enough to provide a satisfactory measure.

Ownership Changes in Menominee County, Michigan

One of the earlier land use surveys was the inventory of Menominee County, Michigan by the Land Economic Survey in 1925. This county was revisited in 1933 in connection with a land utilization study of several counties in the Upper Peninsula and much of the data was revised. For the purposes of this paper only the broader ownership aspects of the changes noted will be discussed.

In revising the ownership data the method of the Land Economic Survey was employed, namely, the recording of intent in ownership on the basis of information derived from the tax rolls and the township supervisors.[1] Instead of covering the entire county, however, the recent study stripped the area, obtaining a 12½ per cent sample. Strips were drawn diagonally across the original ownership maps at two-mile intervals, and the present status of every forty bisected by the strips determined. Parcels more or less than forty acres, such as lake lots, were treated as forty acre units for the sake of uniformity. Also, areas within town and village limits

[1] See Section on Intent in Land Ownership in Soil and Agricultural Report, Menominee County, 1925. Michigan Land Economic Survey.

were excluded. For these reasons the total area figure shown in Table 1 does not correspond with the actual county area. The distribution of ownership intents in 1925 and 1933 is also given in Table 1.

Table 1 shows that a decrease of 2.3 per cent in the area of land held ostensibly for productive purposes (active farm, timberland, residence, etc., recreation and fur farm) has occurred, although a new use has appeared, namely, the development of fur farming.

The area of land held for speculation has decreased, but this has been due less to a shift to productive uses than to a reversion to state ownership for non-payment of taxes. (See Table 3). The 13,760 acres listed under the Pearson Timberland Tax Law are included under speculative intent because their owners are not interested in forestry but in lower taxes. According to the township supervisors, some of the land is being used for hunting purposes by the owners, although the law provides that listed areas be open to public hunting. Now that the Fifteen Mill amendment has been enacted, there will be no further incentive to continue listing these lands.

Net changes in ownership, however, do not tell the whole story and for this reason Table 2, showing the shifts to and from each ownership, is inserted.

During the period, 185,280 acres or 27.6 per cent of the total area was involved in changes. As might be expected, the greatest changes occurred in the speculative, timberland, active farm, and state ownerships. In the speculative class, however, the relative net change was 4.5 per cent less than in the active farm class. By far the largest relative net change, if one excepts the new intent that has developed, occurred in state ownership.

The increase in active farm ownership, together with the decrease in abandoned farm ownership, are quite recent effects of the depression and evidence of the reoccupancy of vacant farms. The cause of the decrease in timberland holdings is the liquidation of timber properties through destructive logging. This is also borne

TABLE 1

DISTRIBUTION OF INTENT OF OWNERSHIP, MENOMINEE COUNTY, MICHIGAN, 1925 AND 1933[1]

Owner intent	1925 Acres	1925 Per cent total	1933 Acres	1933 Per cent total
Speculation	313,280	46.5	289,280[3]	43.0
Farming, active	223,040	33.4	250,240	37.5
Timberland	87,680	13.0	36,480	5.4
Farming, abandoned	27,200	4.0	20,800	3.1
Residence, industry, waterpower	10,560	1.6	10,240	1.5
Recreation[2]	4,480	.7	11,200	1.7
Mineral	320	.05	----	.0
Fur farming	----	.0	2,240	.3
State	4,480	.7	50,560	7.45
Federal	320	.05	320	.05
Total	671,360	100.0	671,360	100.0

[1] Areas calculated by multiplying number of items in the 12½ per cent sample by 8 and then by 40 acres.

[2] Areas shown for both years are larger than the actual because recreational lots are generally under 40 acres in size. This makes the apparent increase greater than the actual, but it does not obscure the trend.

[3] Includes 13,760 acres of cut-over land listed under the Pearson Timberland Tax Law.

out by records of large forest land owners which show that of a total of 75,086 acres in holdings 1,000 acres and over, only 5,014 acres now contain merchantable sawtimber or pulpwood. The increase in recreational ownership is accounted for in part by the marked growth in individual cottage holdings and in part by the development for resort use, hunting and fishing and private game preserves, of properties originally acquired for waterpower purposes.

Addditional light is thrown on the significance of shifts in ownership intent and on the stability of given ownerships by Table 3.

From Table 3 the changes to and from given ownerships as well as their former and current status may readily be observed. As regards speculative ownership, for example, 47,040 acres, or 77 per cent of the total area, going *into* that intent during the period were formerly in timberland ownership, and of the total present area of state land, 39,680 acres or 86 per cent were in private speculative hands in 1925.

The 3,520 acres formerly speculatively held but now in abandoned farms should also be noted. During the short period the lands passed first into active farm use, then were abandoned, and evidently most of them will pass either to speculative ownership again or more directly to state control through tax reversion.

The shifts in active farm ownership also deserve attention. Menominee County ranks first of all the Upper Peninsula counties in value of farm lands and buildings and in returns from field, orchard and woodland crops, and is most favorably situated with respect to markets. Yet, the agricultural utilization of land has not always been satisfactory from the standpoint of economic returns. Thus, although 47,680 acres entered that use during 1925-1933, 20,480 acres passed out of that use in the same interval, very largely into non-productive uses.

Failures in agricultural enterprises may, of course, occur even under the best conditions, but the hazards are undoubtedly greater under the present uncontrolled methods of land use. As a matter of fact, it was found that much of the 47,680 acres going into active farm use is definitely submarginal, either because of poor soil, costly clearing, or both.

Similarly, the origin and magnitude of the shifts in all other ownerships may quickly be observed from the table.

Tax Delinquency and Ownership

Additional evidence of the relative stability of various ownerships is furnished by examining the intent in ownership of

Table 2

SHIFTS IN OWNER INTENT, MENOMINEE COUNTY, MICHIGAN, 1925-1933

Owner intent	Shifts to (Acres)	Shifts from (Acres)	Net change (Acres)	Net change (Per cent)
Speculation	61,120	85,120	—24,000	— 7.7
Farming, active	47,680	20,480	+27,200	+ 12.2
Timberland	1,920	53,120	—51,200	— 58.4
Farming, abandoned	11,840	18,240	— 6,400	— 23.5
Residence, industry, waterpower	6,400	6,720	— 320	— 3.0
Recreation	8,000	1,280	+ 6,720	+ 150.0
Mineral	-------	320	— 320	— 100.0
Fur farming	2,240	——	+ 2,240	------
State	46,080	——	+46,080	+1,028.5
Total	185,280	185,280		

TABLE 3

STATUS IN 1925 OF LAND IN OTHER OWNERSHIPS IN 1933
OWNER INTENT 1933

(ACRES)

Owner intent 1925	Spec.	Farm, active	Timber	Farm aband.	Res. etc.	Recreation	Fur farm	State	Total
Speculation	....	27,840	1,920	3,520	5,120	5,120	1,920	39,680	85,120
Farm, active	9,600	....	....	7,360	640	640	320	1,920	20,480
Timberland	47,040	2,240	....	320	....	640	....	2,880	53,120
Farm, abandoned	3,200	13,440	....	....	320	640	....	640	18,240
Residence, etc.	640	4,160	....	640	....	960	....	320	6,720
Recreation	320	....	....	....	320	....	....	640	1,280
Mineral	320	....	....	....	....	....	....	....	320
Total	61,120	47,680	1,920	11,840	6,400	8,000	2,240	46,080	185,280

the long-term tax delinquent lands (lands delinquent for two and one-half years or more and offered for tax sale one or more times—Table 4). This represents the intermediate stage in the reversion to state ownership which in Michigan is consummated in from five to eight years after taxes become delinquent.

Speculatively held lands plainly contribute by far the most to tax delinquency. They account for 85 per cent of the total delinquent area, though they comprise only 43 per cent of the total area. Expressed in another way, nearly 26 per cent of the speculative land is delinquent as compared with the average for the county of 14 per cent. This relationship is very similar to that brought out in the column of state ownership in Table 3.

The relatively high percentage of delinquency shown for fur farm ownership, while based on a small sample, is borne out by observations on the several fur farms in the county.

The growing significance of tax delinquency is further suggested by the fact that a very small proportion of the reverted lands is going back into private ownership, whether by homestead deeding or sale. No such return to private ownership was noted from the sample study and the records of the Conservation Commission[2] show, for example, that while 41,261 acres were deeded to the state by the Auditor General in the two years 1929-1930, only 359 acres were sold or disposed of to private parties during the same period.[3] This is a ratio of only .9 per cent, as compared with the corresponding ratio for the entire Upper Peninsula of 7.8 per cent. This was, in fact, the lowest ratio for all the counties in that region.

[2] Fifth Biennial Report, Michigan Conservation Commission, 1929-1930. Table 2, p. 123; Tables 8 and 9, p. 127.

[3] In this connection it should be noted that the Conservation Department restricts the sale and deeding of land to areas which, on examination, are found suitable for agricultural use.

Where the conclusions drawn from a given study are to be immediately applied, as for use in public land acquisition, or zoning, later studies may not often be required, but since this is seldom the case the need is increased with each year that elapses. And even after a land classification is made and zoning regulations applied, periodic reviews of the current ownership and land use situation are desirable for the most effective functioning of the plan.

Value of Periodic Studies

Any conclusions that may be drawn from the above analysis of ownership changes for the county as a whole must bear in mind the influence of the widely differing physical and economic characteristics of the various townships and natural districts.[4] But even from these general observations the advantages of conducting periodic studies are apparent. The later studies can be made at a fraction of the time and cost of the original studies, particularly if sampling is resorted to. Only a week and a half of one man's time was required to obtain in detail the data utilized in the above discussion, plus additional data on taxes and assessed values. Usually it will be unnecessary to revise the basic physical data such as that on soils, topography, and site. So far as changes in land use are concerned, part of the information will be acquired in the course of procuring current ownership and in reviewing the census reports. Changes in the character and condition of the cover on the larger forest holdings can be noted to some extent from timberland owners' records and from fire reports, but if details are desired field work will be necessary.

Table 4

DISTRIBUTION OF LONG-TERM DELINQUENCY BY OWNER INTENTS, MENOMINEE COUNTY, 1933[1]

Owner intent	Area (acres)	Delinquency: Per cent owner intent	Delinquency: Per cent total delinquency
Speculation	74,560	25.8	85.0
Farming, active	9,280	3.7	10.6
Timberland	960	2.6	1.1
Farming, abandoned	2,240	10.9	2.5
Residence, industry, water power	320	3.2	.4
Recreation	....	.0	.0
Fur farm	320	14.3	.4
Total	87,680	14.3	100.0

[1]Delinquency status from state tax land map of Menominee County, checked January 1, 1933.

[4]The influence of these factors on ownership and delinquency are now being analyzed in connection with the larger study from which the material for this paper is drawn.

RECENT DISCOVERIES CONCERNING THE BIOLOGY OF THE MOUNTAIN PINE BEETLE AND THEIR EFFECT ON CONTROL IN WESTERN WHITE PINE STANDS

By DONALD DeLEON,[1] W. D. BEDARD,[2] AND T. T. TERRELL[3]

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This paper is a summary of the studies during 1930, 1931 and 1932 in the white pine stands of eastern Washington and northern Idaho, of the biology and habits of Dendroctonus monticolae Hopk. Previous studies have never fully accounted for the rapid increase in the number of infested trees during outbreaks, nor have they adequately explained increases which have occurred subsequent to control work in several instances. Factual knowledge along such lines is essential to the efficient planning and execution of future control projects.

THE mountain pine beetle (*Dendroctonus monticolae* Hopk.) is unquestionably the most destructive insect in the stands of western white pine (*Pinus monticola* Doug.) and lodgepole pine (*Pinus contorta* Loud.) in the Northwest. Since 1910 approximately 50 control projects have been conducted on various national forests and parks in U. S. Forest Service Regions 1 and 4 in an effort to stop infestations of this insect and to preserve the adjacent timber stands from depletion. Approximately $817,900 have been expended in the attempted control of these infestations, which involved the treatment of 463,200 trees on more than 1,219,000 acres. These figures include only the control work in western white pine and lodgepole pine in Regions 1 and 4, and do not consider expenditures for control of mountain pine beetle infestations in other Forest Service regions or projects involving this insect in other tree species.

Such a tremendous expenditure, with the aim of forest protection, of necessity required that a portion of the investigative force of the Forest Insect Field Station at Coeur d'Alene, Idaho, be assigned to study the problems which confronted the control administrators and to supply fundamental information upon which improvements in control methods could be based. Previous studies concerning the ratio of the brood of the mountain pine beetle emerging from an infested tree to the number of beetles that attack the tree have never fully accounted for the rapid increase in the number of infested trees during outbreaks, nor have they adequately explained increases which have occurred subsequent to control work in several instances. In an effort to answer these important questions, investigative work has been concentrated during the past three years on a study of the biology and habits of this insect, the results obtained by various control methods, and the percentage of attacks that occurred because of the escape of adult beetles following control work.

The data recorded in this paper are a summary of the studies which were conducted in 1930, 1931, and 1932 in the western white pine stands of the Kaniksu National Forest in eastern Washington and the Coeur d'Alene National Forest in northern Idaho. The writers express their thanks to the officers of these forests for the courtesies extended to the workers

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and also to the men who assisted in the field work.

PARENT ADULT EMERGENCE AND REATTACK

The habit of parent bark beetles of emerging after their initial attack and attacking another green tree during the same season does not appear to be unusual. This habit has been noted for several species in Canada. Watson[4] records the spruce bark beetle (*D. piceaperda* Hopk.) as cutting two sets of egg galleries in green trees in one season. Simpson[5] states that beetles of *Polygraphus rufipennis* (Kby.) excavate three sets of egg galleries in one season and a fourth the following season before they die. In his second paper Simpson records the larch bark beetle (*D. simplex* Lec.) as cutting three sets of egg galleries in one season. Swaine, in his introduction to Simpson's first paper, mentions that both *Ips perturbatus* (Eichh.) and *I. borealis* Sw. construct two sets of galleries in one season. In later investigations Rust[6] has stated that *Ips oregoni* Eichh. excavates at least four galleries in one season, and Bedard[7] has found that the Douglas-fir beetle (*D. pseudotsugae* Hopk.) cuts two sets per season.

In our work the first indications that the mountain pine beetle might have this habit were recorded in 1928 and 1929, when workers of the Bureau of Entomology noted that emergence holes leading from egg galleries were present in lodgepole pine trees infested with this insect. However, in a report on the Northeastern Oregon Control Project of 1912, W. D. Edmonston had remarked on the early attacks in the Whitman National Forest, and Dr. A. D. Hopkins had commented as follows: "It is very evident that some of the earlier attacks in June were by overwintered parent adults which undoubtedly are capable of excavating more than one set of galleries." It was obvious that if these parent adult beetles emerged from trees after propagating one brood, and reattacked green trees to generate a second brood, the number of infested trees the following year would be approximately twice the number normally to be expected, and this would in a great measure explain undue increases of this insect heretofore recorded.

To determine whether the mountain pine beetle does attack two or more times, infested pieces of western white pine containing new attacks of this insect were caged at the bases of four green trees, so that if parent beetles emerged and attacked the green tree there would be a definite connection between one group of emerging beetles and a subsequent attack.

In each cage the parent beetles emerged from the infested material and attacked the tree. Concurrent with these attacks the green trees were attacked above the cages, and it was noted that parent adults were emerging from the trees from which the infested material had been cut. When it was certain that no more parent beetles would emerge, the cages were transferred to another set of green trees. The old trees were then felled and the formerly caged portions were transferred to the cages on the green trees in order to ascertain if the insects would make a third attack. In only one case were third attacks found, but as only three beetles

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[4]Watson, E. B., 1928. The bionomics of the spruce bark beetle, *Dendroctonus piceaperda* Hopk. Scien. Agr. 8:613-635, illus.

[5]Simpson, L. J. 1929. The biology of Canadian bark beetles. Canadian Entomologist 61:145-151, and 274-279. (Introduction by J. M. Swaine.)

[6]Rust, H. J. 1932. Unpublished preliminary report on the biology of *Ips oregoni* Eichh. and associated insects. Manuscript of the Forest Insect Field Station, Coeur d'Alene, Idaho.

[7]Bedard, W. D. 1931. Unpublished report on Douglas-fir investigations. Manuscript of the Forest Insect Field Station, Coeur d'Alene, Idaho.

had attacked the green tree, it was thought that they might have been jarred from the logs with small fragments of bark when the logs were placed in the cage and hence did not indicate a true emergence and third attack.

All the material, both the original infested logs and the logs containing second attacks, was examined thoroughly at the conclusion of each experiment, and it was found that, although an average of 64 per cent of the parent adults had emerged from their first attacks, there were many dead adults in these logs. It is known, however, that parent adults and new adults are attacking at the same time and consequently attack trees together. These dead beetles, then, were probably, for the main part, parent adults which had made their second attacks.

Although in two of the four cages all of the parent adults emerged and made second attacks shortly after their initial attacks, a number of the beetles in the other two cages wintered in their first host and did not make second attacks until the spring of the following year. In one of these cages the original attack was made August 11, 1931, and although forty-nine per cent of the parent beetles had emerged 23 days later, an additional 7 per cent emerged and made second attacks the following spring. In the other cage the initial attack was made August 28, 1932, seventeen days later in the season than the preceding cage; hence only 18.1 per cent emerged the same year, while 47 per cent overwintered and made second attacks in the spring. It is to be expected that the later the attack the smaller will be the number of parent adults which emerge in the fall, and the greater will be the number that winter over and emerge during the following spring.

In order to ascertain the rate of parent adult emergence, a definite area was cruised every three days, and as newly attacked trees were found, each was numbered and the date of attack recorded. The entire basal area to a height of 5 feet was marked off on 30 trees and examined every second day for parent beetle emergence holes. Each hole was marked with crayon to prevent recount.

These data show that the beetles which emerged from their first attacks during the same season began emerging from 7 to 32 days after the attack, the average interval being about 19 days, and that the peak of their emergence occurred from 3 to 20 days after the first emergence, the average interval being about 11 days. From six trees which were attacked late in 1930, a few beetles emerged the year of attack, but the greater number wintered over and emerged the following spring. Similarly in five trees which were attacked later than the preceding group, all the parent beetles wintered over and emerged to make their second attack the following spring.

From these studies it can be stated that mountain pine beetle adults attacking western white pine emerge from the trees after making one attack and enter other green trees to make a second attack. It is obvious, therefore, that the rate of increase of any infestation is nearly twice as great as was formerly believed, and that the potential danger of any infested material overlooked in control is approximately doubled.

Proportion of Sexes

Investigators have reported from time to time that unequal numbers of male and female mountain pine beetles are to be found in the galleries of newly attacked trees, and inasmuch as the females are in the majority, the rate of increase would be greater and in direct proportion to the number of extra females. An examination of 4,010 adults taken from the egg galleries in newly attacked trees showed that 60.8 per cent were females

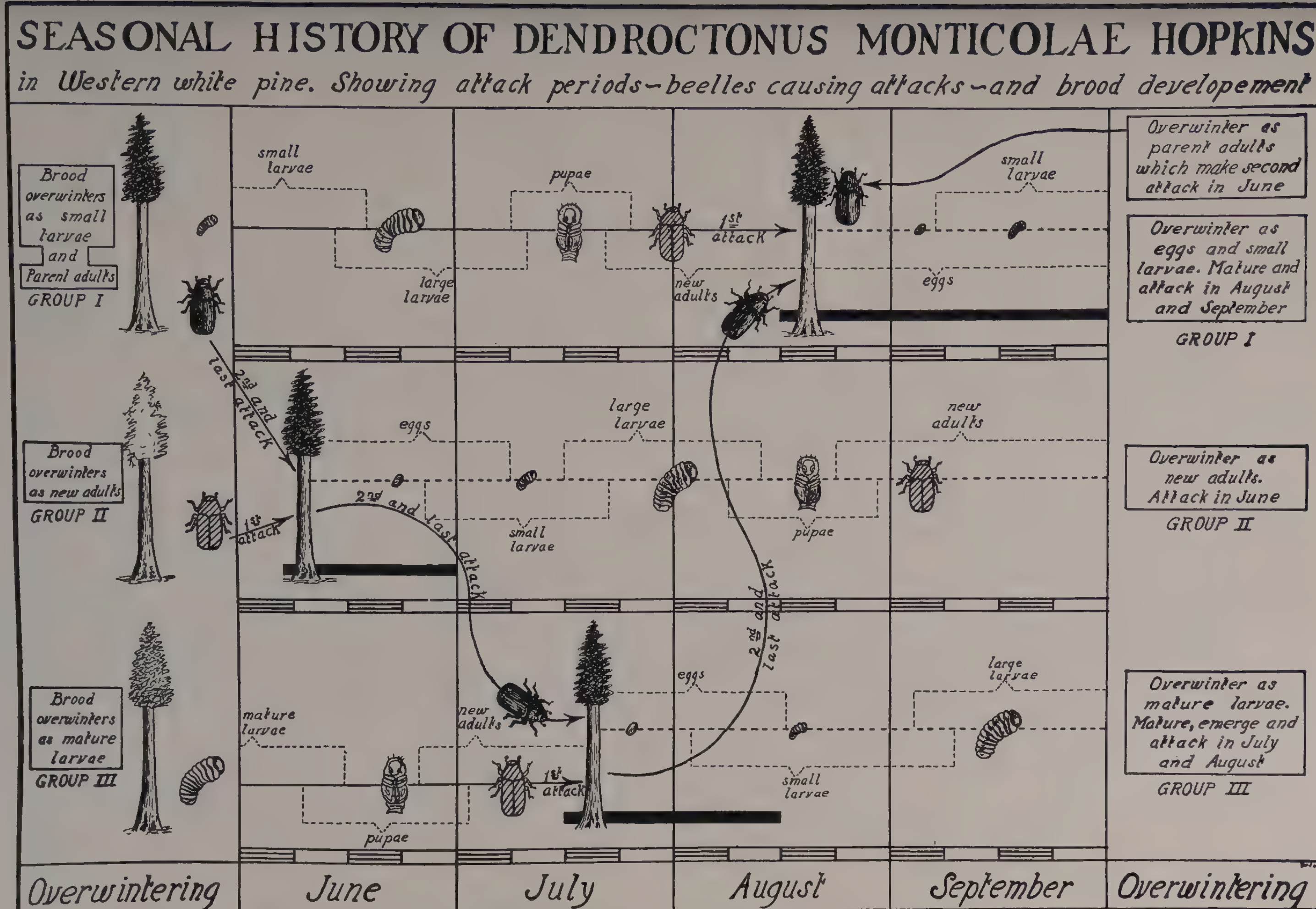

Fig. 1.—Black lines extending from tree bases represent periods over which attacks are made. Parent adults (beetles that have made one attack) are represented in black. New adults (beetles that have not yet made their first attack) are represented in cross-hatch. Brood development is shown for each attack period by the brood stage and a broken-line bracket designating the period during which that stage is present in the tree.

and 39.2 per cent males. However, by examining 2,500 new adult beetles taken from new broods ready for emergence, it was learned that male and female beetles are present in equal numbers before they emerge from the brood trees and make their initial attack. The numerical inequality of sexes in new attacks does not arise, therefore, from an extra production of females and consequently does not become a factor which causes an increase of the mountain pine beetle beyond that normally expected.

The inequality of sexes in the new attacks is due to the fact that many males die in the egg galleries after the first attack, and, therefore, parent beetles emerge in a ratio of 2 females to every male. These parent beetles, in a ratio of 2 females to 1 male, attack the trees together with new beetles which are in a ratio of 1 female to 1 male, and thus the ratio of sexes in new attacks becomes 3 females to 2 males.

Seasonal History

Before discussing the effect of the early attacks of the mountain pine beetle on the control of this insect, a summary of the seasonal history will be given so that a complete understanding will be had of the various attack periods and the beetles which cause them.

During the active season in northern Idaho and eastern Washington there are three periods of attack by the mountain pine beetle, and thus in the early spring, before insect activity begins, the trees then infested may be classed in three different groups, based on the period in which each was attacked. A survey of 275 infested trees in an untreated infestation in the Sullivan Creek drainage of the Kaniksu National Forest showed that 24.4 per cent of the brood overwintered in trees containing only parent adults and young larvae (Group I), 25.1 per cent in trees containing mostly young adults (Group II), and 50.5 per cent in trees containing mature larvae principally (Group III).

The first attacks begin early in June and continue throughout the month. These are made by the combined efforts of the overwintering parent adults from trees in Group I and the overwintering new adults in Group II. The brood from these June attacks develops normally and is mostly in the new adult stage by the first of September. These beetles continue to feed in the trees throughout the warm days of fall, and a few emerge, but the majority overwinter and emerge to attack in June of the following year. This is the brood found as new adults in the spring.

The main emergence begins near the middle of July and continues to the middle of August. This exodus comes from the trees in the third group, i. e., those containing mature larvae which have now developed into new adults, and also includes the adults which attacked for the first time in June and are now emerging to attack again and generate their second and final brood. The overwintered parent adults which assisted them to make the June attacks do not emerge because they performed their second and final attacks by going into the June trees. The broods generated by this main attack develop fairly rapidly and are more or less mature larvae at the close of the season, overwinter in this stage, and emerge in late July and early August of the following year. This is the brood found as mature larvae in the spring of the year.

The final attack period in reality is the tapering off of the main attack, but inasmuch as the larvae are so immature at the close of the season, these late attacks are grouped in a separate attack period. It begins about the middle of August and continues to the end of the active season which is usually late in September. These

attacks are made by the brood from the trees in Group I which in the spring contained small larvae that have now matured into new adults. The attacks at this time are also augmented by the parent beetles from the main attacks of July and early August which (excepting those having already made their final attacks) are now emerging and making their second attacks. The brood from this final attack period overwinters as small larvae and emerges during August and September of the following year. Those parent adults in this group which have not made their second attacks, overwinter and emerge in June of the following year to attack again.

Regarding this seasonal history, three things must be remembered. First, no tree contains a "pure line," that is, no tree contains brood propagated entirely by new adults, or entirely by parent adults making their second attack. Instead, inasmuch as parent adults are attacking simultaneously with new adults during all three attack periods, they attack the trees together and may be found in varying percentages in the different trees. Second, although the sequence of events will remain the same, climate will exert a very pronounced influence on brood development and thus may change the dates of the events if the yearly climatic variations are sufficiently pronounced. Third, individual variations sometimes occur which do not conform to the general seasonal history.

June Attacks

The preceding seasonal history has shown that in the early spring there are trees containing overwintering new adult beetles, and other trees containing overwintering parent adult beetles, and that these overwintering new adults and parent adults emerge and attack green trees during June, at which time spring-control operations are usually in progress. It is apparent that, where the control method comprises the felling and peeling of infested trees, most of these adults ready to emerge will not be destroyed and will make their attacks in green trees.

To test this, two white pine windfalls which had been attacked in June, 1931, were peeled on June 12, 1932. Over a portion of the peeled bark a cage was constructed which allowed for the ingress of small mammals and other predators but prevented the beetles from escaping. Although some mortality occurred, a high percentage of the beetles survived and made successful attacks in a green log which had been placed in the cage.

Thus, by peeling the infested trees during the spring, little reduction is secured in the number of June-attacked trees, although a good reduction may be secured in the number of trees attacked at other times. It is logical to assume, therefore, that where this method of control has been utilized for several successive years the infestation would gradually change from one comprising 25 per cent June attacks to one with a preponderance of these early attacked trees, even though the total infestation had been materially reduced. It is also obvious that the later attacks can not be reduced beyond a certain point because the new adults which attack in June emerge and attack other green trees in July of the same year.

To test this hypothesis, a survey was made on two separate areas following the 1932 spring control work on the Coeur d'Alene National Forest. This project has been conducted annually since 1929, and the work has been done by peeling the infested trees. The trees on a total of 460 acres on the Yellow Dog River and Downey Creek units were examined in the period between June 17 and June 23, and showed that an infestation of 0.388 June-attacked tree per acre on the Yellow Dog unit and 0.154 June tree per acre on the Downey

Creek unit had occurred during and subsequent to control work. These areas were recruised between August 24 and September 1 to determine the number of attacks that had occurred subsequent to the previous survey. This check showed a total infestation of 0.535 tree per acre on the Yellow Dog unit and 0.154 tree per acre on the Downey Creek unit. Thus, the June-attacked trees comprise 72.5 per cent and 100 per cent of the total infestations on these two areas, under intensive control, as compared with 25 per cent in untreated epidemics. It will be noted that the June trees comprise 100 per cent of the infestation in the Downey Creek unit. This is due to an unusual situation that has developed following the control on the Coeur d'Alene Forest. The June trees are never completely filled in by the attacking beetles, and sufficient bark space remains for infestation later by beetles during subsequent attack periods. The attacks in the June trees on the Downey Creek area were so few, therefore, that these trees completely absorbed the attacks made during the remainder of the season.

From this study it can be seen that the peeling method of control is not conducive to good results when utilized in the spring to control infestations of the mountain pine beetle in western white pine.

Summary

Intensive investigative work concerning the habits of the mountain pine beetle in western white pine has been conducted during a three-year period to secure data whereby improvements in control methods could be made. The studies have shown that this insect emerges from the tree which it attacks first and attacks another green tree during the same season. This habit accounts for the rapidity with which infestations increase when the apparent brood potential does not indicate such an increase.

The preponderance of female beetles in newly attacked trees, previously thought to be an important factor of increase, has been found to be negligible because the broods of this insect emerge with males and females equally represented.

The work has also shown that the peeling of infested white pine trees in the spring in an effort to control the mountain pine beetle does not destroy the adult beetles which are found in 25 per cent of the trees. This tends to increase the percentage of June-attacked trees even though a substantial decrease in the total infestation is secured. It also allows the parent beetles from these early attacks to emerge and make additional attacks in July.

HAVE YOU SUFFICIENT KNOWLEDGE CONCERNING THE SOIL IN YOUR FOREST?

By RALPH C. HAWLEY and CHESTER A. COOVER

THE successful forest manager should possess (in addition to much other knowledge) complete information as to the character and condition of his land and forest. While the truth of this statement is self-evident, accomplishment of the desired end is necessarily slow and is usually attained in greatest degree with respect to such items as timber estimates. Other features such for instance as the condition of the soil for producing forest crops may have received little attention.

Land has often been classified into several production classes based in a rough way upon the amount of forest products which the land could produce as judged by existing crops. But in most cases nothing has been done toward determining whether the soil on given land units was in the best possible productive condition. In this brief article it is proposed to discuss a study[1] made in the Eli Whitney Forest, New Haven, Connecticut, during the summer of 1932 to obtain preliminary information concerning the condition of the soil.

Agricultural experts have already developed methods for ascertaining the condition of the soil on farm lands and have become proficient in improving soil fertility and hence crop production by the application of fertilizers to supply deficient elements. Similarly in forest crop production, methods for ascertaining the condition of the soil ought to be developed and knowledge acquired as to practicable means of improving forest soil fertility. Certainly the application of fertilizers as used in agriculture is impracticable. Forest soil improvement may come principally through maintaining crops of the correct composition and through protection and silvicultural treatment of the stand. Consequently a thorough knowledge of silviculture is fundamental to the development of efficient forest soil management.

Romell and Heiberg, among the workers in this country, have been outstanding in stressing what may be termed the sanest approach to the appraisal of forest soil condition and its improvement. They have emphasized the importance of the humus layer in controlling surface soil condition and, as their principal original contribution, have proposed a classification of the humus layer[2] which should prove of value both to the research worker and to the practicing silviculturist. By "humus layer" is meant the top layer of the soil characterized by its content of organic matter which may be high or low and may occur either as a layer upon the mineral soil or incorporated with the soil. It does not include the fresh organic debris (litter) which as yet shows little evidence of decomposition.

The immediate purpose in studying the humus layer in the Eli Whitney Forest was to determine the situation in regard to types of humus layer represented in the forest, and to test the workability under

[1] Coover, Chester A. 1933. The Nature of the Forest Humus Layer in the Eli Whitney Forest. A manuscript report in the library of the Yale School of Forestry.

[2] Romell, L. G. and S. O. Heiberg. 1931. Types of Humus Layer in the Forests of Northeastern United States. *Ecology* 12 (3): 576-608.

Connecticut conditions of the humus layer classification suggested by Romell and Heiberg. Ultimately it is hoped that practicable treatment for improving soil conditions in the individual stands can be developed.

A representative sample was obtained by studying the humus layer on 163 areas distributed throughout the various cover types and age classes proportionately to the area occupied by such units. Three soil pits were opened on each area, field measurements and observations recorded and samples taken into the laboratory for analysis of organic content and acidity.

In general the classification of humus layer types proposed by Romell and Heiberg proved applicable to southern Connecticut conditions. Long periods of abusive treatment such as frequent burning over, heavy grazing and clear cutting at too frequent intervals have on portions of the forest area inhibited the development and maintenance of the characteristic humus layers to be expected on properly managed lands of the same forest types. Thus many immature forms of humus layer were found but on the whole there was little difficulty experienced in placing samples under the Romell-Heiberg classification. This classification recognizes two groups of humus layer types, namely, the mull group in which the humus material is incorporated with the mineral soil and the duff group in which a pronounced layer of unincorporated humus covers the ground.

Four divisions are recognized under the mull group—crumb, grain, detritus and twin mulls, and under the duff group four divisions—root, leaf fibrous and greasy duffs. All these humus layer types were found in the Eli Whitney Forest with the exception of fibrous duff.

Table 1 shows the distribution of the humus layer types by cover types. The cover types listed in Table 1 are those used for purposes of management in the Eli Whitney Forest and do not check exactly with those recognized by the Society of American Foresters, (See JOURNAL OF FORESTRY 30 [1930] 451 to 498.) The hardwood type comprises all mixtures of broad-leaved trees occurring on well-drained areas with the exception of the mixed stands containing eastern hemlock. The latter are placed under the hemlock-hardwood type. The pine type includes all the coniferous plantations, composed chiefly of eastern white and red pines. The hardwood swamp type and the southern white cedar swamp types are respectively numbers 26 and 90 in the Society of American Foresters cover type classification referred to above.

Out of the 160 study areas within forest types, 128 or 80 per cent come under the mull group. Eighty-one per cent of the 111 areas in the hardwood type fall within the mull group. Twin mull, crumb mull and root duff are the three types of

TABLE 1

DISTRIBUTION OF HUMUS LAYER TYPES BY COVER TYPES

Cover type	Crumb mull	Grain mull	Detritus mull	Twin mull	Root duff	Leaf duff	Greasy duff	Grass mull	Total
	Number of study areas								
Hardwood	34	7	4	45	18	3			111
Pine	20	13	1	1					35
Hemlock-hardwood		1		2		4			7
Hardwood swamp							6		6
Southern white cedar swamp							1		1
Open fields								3	3
Total	54	21	5	48	18	7	7	3	163

humus layers commonly found in the hardwood type. The stands in the pine type are plantations established in most cases on lands formerly used for agriculture. The stands sampled were between 15 and 33 years of age. They comprise pure white pine, pure red pine and mixed red and white pine with a few examples of Scotch pine, Norway spruce and European larch.

All study areas within the pine type were classified as belonging in the mull group,—principally crumb and grain mulls. It is true that because of the age of the plantations mature humus layers had not developed and the humus layers found were not such perfect examples of the crumb and grain mulls as occurred in many hardwood stands. Nevertheless they were best classified in the mull rather than in the duff group. The few Scotch pine and European larch stands sampled already had humus layers of excellent crumb mull. White pine showed a better type of mull development than did red pine. It is not known whether the present favorable soil conditions under young pine stands are due entirely to the beneficial influence of the plantation or whether they persist from the old field condition. Whether with advancing age the white and red pine stands ultimately will develop a mull or duff type of humus layer remains to be seen.

Hemlock-hardwood stands showed both mull and duff conditions but inclined toward a leaf duff which may be characteristic of this type. The hardwood swamps and southern white cedar swamps have humus layers of greasy duff. This type of layer was found only in the swamps.

The chief point of interest to the forest manager is whether and to what extent the different types of humus layer can be correlated with the productive capacity of the site. The present preliminary study cannot answer this question other than to indicate possible trends. The investigations indicate a gradual but consistent decrease in fertility in going from crumb mull at the upper extreme to greasy duff at the lower limit. Plant growth and site conditions on areas with humus layer types other than crumb or grain mull sometimes appear to equal those of areas with crumb mull. But examination shows that areas with good crumb mull usually support a greater variety of species and more productive stands. Crumb and grain mull are more characteristic of the better site qualities[3] while the duff forms of humus layer predominate on the poorer sites. Twin mull occurs most frequently on the medium quality sites.

Crumb mull as sampled here is characterized by a greater abundance and larger number of species of soil fauna than any other type of humus layer. Large earthworms are especially characteristic. This in itself may indicate a forest soil in the best of tilth. The best examples of crumb mulls were found under hardwood stands over 20 years of age on well-drained swales and lower slopes.

Such is the present situation. It remains to be seen whether with the cessation of forest fires, grazing and other forms of mismanagement and with or without the application of intensive silvicultural treatment the better types of humus layer can be developed throughout the forest. That improvement on many areas can be attained seems certain. Possibly it may be found that moisture relations and forest composition are paramount factors (under given climatic conditions) which determine the type of humus layer to be found on each site quality.

It may be that each forest cover type develops a humus layer type differing

[3] Lands in the Eli Whitney Forest are divided into five site classes based largely upon moisture relations as indicated prinicipally by topography, aspect and depth of soil.

from that characteristic of certain other forest cover types. This would lead to the inference that best growth and perhaps the most promising reproduction may occur in one forest cover type when the humus layer is, for example, a leaf duff while in some other cover type best growth is secured only with a crumb mull humus layer. The best humus layer conditions which can be attained in each of the various forest cover types are, at least, in southern Connecticut, as yet undetermined for all these types although evident for some cover types. Appraisals such as the one described followed over a period of years by observation of changes in humus layer conditions which may take place on specified areas should result in obtaining for the forest manager much of the information he needs concerning the conditions of his forest soil.

VALUE OF CHEMICAL COMPOUNDS IN FIRE EXTINGUISHING, FIRE RETARDING, AND FIREPROOFING, WHEN APPLIED TO VEGETATIVE GROWTH

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Considerable progress has been made in research on the use of chemical compounds in forest fire control, indicating a decided field for them under the peculiar conditions existing in the watershed areas of the Southwest. The publication of this article, it is hoped, will stimulate further discussion along the same lines.

THE Los Angeles County Forestry Department has long recognized the potential value of chemical compounds in the eradication of vegetative growth fire hazards, and as an agent in fireproofing and fire suppression. Vegetative growth fire prevention and suppression in Los Angeles County presents unusual difficulties; because of climatic conditions, topographical characteristics, and cover type.

This is a semi-arid region; with long periods of extremely low relative humidity and readings of 6 per cent not uncommon; frequent high velocity winds; a three months' rainy season, with rains usually of torrential nature. Precipitous mountain slopes, rising suddenly from valley floors to an elevation of seven to eight thousand feet, comprise the most valuable watershed and include a vast extent of not easily accessible area. The predominant growth is composed of many varieties of shrubs, known as chaparral, with bread leaf species in the lower canyons and coniferous types in the higher elevations. Annual and perennial weed, grass, and flowering plant growth are prolific. The season of extreme fire hazard ranges from eight to twelve months of the year, and extensive forest patronage adds to the abnormal natural risk.

All these factors combine to make it of the utmost importance to discover efficient agents for fire extinguishing, fire retarding, and fireproofing, which can be put to practical use; and especially those which can be applied effectively in isolated areas. Weather conditions and isolation were the principal causes of the denudation of 219,000 acres in the Santa Barbara National Forest in 1932. Unquestionably, if a practical method of applying chemical fire extinguishing and retarding agents from airplanes had been previously perfected the use of such method would have prevented much of the damage done by this fire. At the suggestion, and with the assistance, of this Department comprehensive research has been carried on relative to the complex behaviors involved. Experiments are still in progress, but sufficient time has not yet elapsed to form definite conclusions regarding the tests made.

Many combinations of the compounds derived from the elements in group five, the polyvalent group of the chemical periodic series, and other groups, have been tested in the laboratory and the field. Particular attention was given to the major influencing factors affecting both efficiency and practicability. These influencing, or limiting, factors; listed in the

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order of their importance; are as follows:

(a) Adaptability as efficient agents.

(b) Cost, and commercial availability.

(c) Animal life hazards.

(d) Metallurgical activity.

(a) In determining adaptability as efficient agents many field problems were encountered. Both liquid and dry agents were experimented with. A fireproofing agent when intended solely for use on live vegetative growth must be so built that it will adhere and spread out in an efficient manner over as much of the surface of growth to be treated as possible. Extensive tests revealed the importance of this required property of both liquid and dry fireproofing agents. Especially forcefully was this condition brought out when working with dust mixtures. Efficiency of spread of a solution is closely related to its surface tension properties. It was early observed that the alkaline, or basic, liquid solutions and dry mixes were more efficient as regards spreading properties than those of an acid nature. Herbacidalists report the same observation.

Thorough tests carried out with materials of a hydroscopic nature, as compared with non-hydroscopic or efflorescent material, revealed that hydroscopic action is no indication of a beneficial fireproofing property. Furthermore, materials of a highly hydroscopic nature have the decided disadvantage of quickly clogging the equipment used for discharging.

Dusts have been given considerable attention, because the development of efficient dusts which could be used practically for drooping from an airplane would be of the greatest value. Limited field trials would indicate that several mixtures of dry materials can be thus used as efficient agents.

The development of the fog nozzle greatly enhanced the efficiency of water in the extinguishing of both hydrocarbon and cellulose fires, because of the improvement in the physical action of the water itself brought about by this method of delivery. An even greater increase in rate of effectiveness is gained by the use of this nozzle for the application of aqueous solutions of non-hydrolizing efficient agents; because the fineness of the division of the stream results in wider spread, with a consequent beneficial effect on adherence, and greater cooling properties. This combination is more efficient than the standard chlorinated hydrocarbons, such as carbon tetrachloride. The rate of efficiency of such a combination as compared to water alone is proportionately 25 to 1.

(b) In determining cost and commercial availability considerable difficulty has been encountered. In but few instances are worthy chemicals available for extensive trials. At times, months of delay have been thus occasioned. It is also difficult to obtain firm costs on the various promising solutions and dry mixes. It is expected that the most practical result of the research and experimentation will be the development of efficient dusts and solutions which can be produced in commercial quantities at a reasonable price.

(c) Relative to animal life hazards, conditions encountered were of a nature which would indicate that most efficient agents must be applied under trained supervision and with proper equipment.

(d) The most efficient dusts and solution, both from a fireproofing and fire extinguishing standpoint, present the problem of being highly active metallurgically. This condition indicates that resistant metal containers will be required for such materials. These, since recent industrial developments, are easily obtainable. The rate of efficiency of the metallurgically active dusts and solutions is much higher

than that of those which are non-active. A 10 per cent solution of stannic chloride, which is highly active metallurgically, is more efficient than a 30 per cent solution of zinc chloride, which is non-active metallurgically.

Observations made while working with the following elements, both singly and in combination, relate to cellulose fire control. It must be understood that the observations are not conclusive. Work of this kind requires so much fundamental research that there is always the possibility of some particular compound being overlooked, and later work may bring out other valuable combinations. Certain elements were not tested because of their rarity, high cost, or apparent lack of value. The elements tested are listed alphabetically, with general remarks as to their efficiency:

Aluminum.—With the exception of aluminum sulphate, which is the standard acid salt used in combination with sodium bicarbonate in the generation or carbon dioxide, none of the salts of aluminum were found to be efficient agents.

Ammonium.—While ammonium is not an element its salts are classified at this time in order to maintain alphabetical order. The ammonium salts, several in number, are well up the scale of efficient agents; the outstanding one being the compound with the arsenite radical and represented as ammonium arsenite, which has the added advantage of low cost.

Antimony.—Antimony ranks very high in the list of effective agents. The physical properties of the element alone make it desirable, for it has a high atomic weight and it can be finely powdered. Several of the compounds of antimony show considerable promise, principally as fire extinguishing agents.

Arsenic.—Arsenic ranks higher than antimony. The difficulty in the use of the various salts of arsenic lies in its highly hydroscopic nature. The trioxide is an exception, however, and is fairly stable at wide ranges of atmospheric moisture.

Bismuth.—Bismuth salts cost several times as much as those of the other members of group five, which prevented extensive tests.

Boron.—The boron salts have a background of years of use as fireproofing agents. The principal compounds are those in which the sodium salt as a tetraborate (borax) is allowed to react with an acid salt of a heavy metal. As an example, zinc borate as made from zinc chloride and borax, and copper borate as made from copper sulphate and borax, are efficient fireproofing agents; especially of wood and wood products. Wood that is allowed to stand in an ammoniacal solution of copper borate becomes deeply penetrated with the solution. Upon drying, the wood will be found to be highly resistant to fire. Other acid salts that lend themselves to use in combination with sodium tetraborate, with the consequent formation of an insoluble precipitate, are nickel sulphate, magnesium chloride, and stannous chloride. The sodium tetraborate alone possesses fireproofing and fire extinguishing properties, but not to as high a degree as in combination with active agents. The acid of boron, boracic acid, is also an efficient fireproofing and fire extinguishing agent, but its cost is several times that of the sodium salt, borax. For use singly, and not in combination, boracic acid is more efficient than the sodium tetraborate, probably for the reason that most of the sodium salts have low fireproofing and fire extinguishing properties.

Bromine.—The element bromine and its salts are efficient agents, but not to so high a degree as chlorine. This may possibly be explained by the fact that

bromine is slower and less intensive in its chemical reactions. The high cost of the salts of bromine prevented extensive field tests.

Calcium.—Calcium salts do not appear to possess either fireproofing or fire extinguishing properties. However, one particular compound, that of gypsum ($CaSO_4$) has been used for years as a fire resistant material in building construction. At high heat this compound is readily decomposed, especially in the presence of carbon.

Chlorine.—Chlorine and many of its salts rank very high as efficient agents. This property is undoubtedly due to the rapid activity of the chemical action of chlorine, both alone and in combination.

Copper.—Copper, both singly and in combination, although not as efficient as other metals, is interesting as a fireproofing agent for the reason that its efficient salts are relatively low priced.

Fluorine.—The complex salts formed as the result of the reaction between silicon and fluorine rank well up the scale of efficient agents. One salt in particular, magnesium fluo-silicate, shows considerable promise.

Iron.—Several iron salts have been used as fireproofing agents. One in particular, ferric chloride, is a low cost, efficient fire extinguishing agent. However, it has the disadvantage of being highly active from a metallurgical standpoint.

Magnesium.—One salt of magnesium the chloride, both singly and in combination, when finely divided has shown promise as an efficient fire retarding and fire extinguishing dust. The same is true of some complex salts of magnesium; especially those with boron, silicon, and fluorine.

Nickel.—The nickel salts display behaviors very closely allied to those of copper, but several times as active. However, the cost is proportionately greater.

Phosphorus.—Phosphorus is an element of group five, and has received considerable attention. Many of its salts, both in dusts and liquid solutions, possess high efficiency as fireproofing and fire extinguishing agents. One solution in particular, phosphorus oxychloride, is the most efficient oxygen inhibiting agent that was worked with. However, it is highly active metallurgically.

Potash.—Potassium carbonate in combination with other salts shows promise as an efficient agent.

Silicon.—Considerable attention was given to the various compounds of silicon, for they possess both relative low cost and efficient qualities as fireproofing agents. The insoluble precipitates formed by the interaction between a soluble silicate and an acid salt, if properly controlled, furnish a practical means for low cost fireproofing. As previously stated, the complex salt magnesium fluo-silicate shows considerable promise.

Sodium.—The sodium salts, except in complex combinations, are not of interest.

Tin.—Several of the tin salts are very efficient fire extinguishing agents, but are relatively high in cost.

Zinc.—The outstanding zinc salt is zinc chloride, which has a background of use as a fireproofing agent. However, recent work would indicate there are more efficient low cost agents for the same use to which zinc chloride is put.

Summary

1. Efficient dust mixtures have been developed which can be applied practically from an airplane.

2. Certain combinations of dry materials added to water increase its fire

extinguishing properties in the ratio of 25 to 1.

3. Efficient dusts and solutions can be produced in commercial quantities at a reasonable price.

4. Highly active efficient agents, both in dry form and concentrated solutions, can be stored in readiness for any fire emergency.

Conclusion

Results already obtained indicate that the value of chemical compounds in fire extinguishing, fire retarding, and fireproofing, is so great that their use can, and will, be developed to the point where the rate of efficiency will preclude the possibility of major conflagrations.

THE SIGNIFICANCE OF THE EFFECT OF STAND DENSITY UPON THE WEATHER BENEATH THE CANOPY

By G. M. JEMISON

Northern Rocky Mountain Forest and Range Experiment Station

During the middle of the nineteenth century forests were believed to have important influences on climate. As climate was more thoroughly understood it became evident that the major climatic controls were beyond the influence of forest cover, a finding which wholly discredited the earlier conclusions. It was evident to the forester and student of ecology, however, that a forest stand has important and under certain conditions critical influence upon plant succession. Accordingly, attention was given to local climate, or micro-climate. An understanding of the significance of the influence of the forest in micro-climate is dependent on comparative measurements which the paper of Mr. Jemison clearly sets forth.

FORESTERS generally recognize that stand density influences the weather, but the magnitude and reliability of apparent differences in soil, air, and duff temperature, air and fuel moisture, wind, and evaporation following complete or partial removal of dense virgin timber have long been matters of speculation for American forest conditions. The significance of real differences in the weather elements is enlightening when their application is considered in the fields of silviculture and fire protection. Information on this subject is of value to the forester in explaining the survival and growth of seedlings, the invasion or succession of vegetation after cutting, and the relative forest fire danger on areas of varying amounts of forest cover.

Relatively few publications are available on the subject. Pearson (7 and 8) emphasized the importance of recognizing the effect of silvicultural systems on the physical factors directly concerned with tree growth. He stated that "too often the forester thinks of the method of cutting as acting directly instead of through its effect on basic physical conditions." Munger (6) compared the evaporation and surface soil temperatures of timbered and open areas in the Douglas fir region. Stickel (9) showed the modifying effect of a forest cover on fire danger in New England, and Larsen (5) made a study of the effect of the removal of a virgin western white pine stand upon the site factors.

The effect of stand density upon the weather and inflammability beneath the canopy has been measured at the Priest River Forest Experiment Station, near Priest River, Idaho, since 1924. Beginning in late 1930 comparable data have been obtained for three sites: one located under dense virgin timber, one under partial cover where about one-half of the canopy has been removed, and the other in the open where there is virtually no forest cover but merely small and widely scattered patches of reproduction. These stations, which are termed the full-timbered, half-cut, and clear-cut areas, respectively, are located within 1,400 feet of each other on a topographic bench where all conditions are comparable except the density of the forest cover. Data obtained on the three areas, through a carefully developed technique, include twice-daily measurements throughout each fire season of maximum and minimum air temperature, relative humidity, wind, evaporation, soil temperature, maximum duff temperature, precipitation, and duff and slash moisture

content, as well as automatic records of relative humidity and duff and air temperature.

In a study of the influence of stand density upon the weather elements beneath the canopy, averages or a comparison of averages fail to tell the story completely unless the reliability of means and of the differences between means is investigated. The average relative humidity on the half-cut area might be three per cent higher than that on the clear-cut area, for instance, but it is possible that these two means do not differ significantly one from the other because of large sampling errors associated with the data.

Using the detailed records, which were available for July and August of 1931, 1932, and 1933, averages and their standard errors were computed, and the results are presented in Table 1.

The standard errors of the means were computed by the formula $\sigma_M = \frac{\sigma_X}{\sqrt{N}}$,

in which

σ_M = Standard error of the mean of the variable X.

σ_X = Standard deviation of the variable X.

N = Number of observations.

Thus the full-timbered average maximum air temperature of 79.3° ± 0.6° indicates that means of similar samples of maximum air temperature would fall between 78.7° and 79.9° two times out of three.

The significance of the difference between two means can be tested by determining the magnitude of the standard error of the difference and comparing it to the difference itself. The observed difference between the mean relative humidities of the clear-cut and half-cut areas was 1.7 per cent with a standard error of ±0.3 per cent. This difference, almost six times its error, was undoubtedly real because in statistical work two or three times the standard error is taken as the level of significance. Three times the standard error was adopted as the level of significance for this study.

An investigation reveals that the differences between the clear-cut and half-cut averages and all differences between the half-cut and full-timbered averages are significant because they are at least three times the corresponding standard errors. These differences are shown in Table 2.

The following formula was used to compute the standard errors of differences between the means of the dependent events:

$\sigma_{X-Y} = \sqrt{\sigma^2_X + \sigma^2_Y - 2r_{XY}\sigma_X\sigma_Y}$ in which

σ_{X-Y} = Standard error of the difference between the means of variables X and Y.

σ_X = Standard error of the mean of X.

TABLE 1

AVERAGES OF WEATHER AND FUEL MOISTURE ON THREE SITES AT THE PRIEST RIVER FOREST EXPERIMENT STATION

Factor measured	Full-timbered area Mean	Full-timbered area Std. error	Half-cut area Mean	Half-cut area Std. error	Clear-cut area Mean	Clear-cut area Std. error
Maximum air temperature, °F.	79.3	±0.6	81.7	±0.7	84.1	±0.7
Soil temp., 1-foot depth, °F.	51.4	±0.1	53.9	±0.1	59.6	±0.1
Max. surface duff temp., °F.	77.0	±0.7	91.6	±1.0	126.9	±1.3
Rel. humidity, 4:30 p.m., per cent	35.8	±1.1	29.0	±1.1	27.3	±1.1
Abso. hum'ty, 4:30 p.m., grs./cu.ft.	3.343	±0.057	2.886	±0.057	2.817	±0.052
Wind movement during day, miles	3.8	±0.2	18.8	±0.6	32.6	±0.7
[1]Evap. rate, grams	40.0	±2.0	77.0	±8.0	163.0	±11.0
Duff moisture, per cent	18.8	±0.9	16.5	±0.9	8.2	±0.6
Branchwood moist. 2" di., per cent	11.1	±0.2	9.5	±0.2	6.4	±0.2

[1]Average evaporation based on measurements taken every 10 days during 1931 and 1932 only.

σ_Y = Standard error of the mean of Y.
r_{YX} = Correlation coefficient of the variables X and Y.

As the foregoing tests of the significance of the differences between means indicate that all differences are real, the averages for July and August, shown in Table 1, can be taken as reliable indicators of the effect of stand density upon weather and fuel moisture beneath the canopy. Knowing that these differences are significant, the results of partial or complete removal of the forest cover are quite striking. It becomes apparent that partial cutting increased the average maximum air temperature two and one-half degrees, while clear cutting raised it five degrees. Soil temperature was increased from two and one-half to eight degrees, and maximum temperature of surface duff as much as 50 degrees. These cutting practices also lowered relative humidity seven to eight and one-half per cent, increased wind movement five to eight times, at least doubled the evaporation, and reduced fuel moisture contents as much as ten per cent.

These averages for a two-month period fail, however, to indicate the extreme conditions which, while they may not last long, have important effects upon seedling survival and upon inflammability. Tables 3 and 4 were therefore prepared to show extremes of duff temperature and fuel moisture. They show emphatically that clear cutting results in extremely dangerous conditions.

One of the most striking features of these tabulations is the extremely high temperature of 158° measured just under the surface of the duff on the clear-cut area. Right at the surface, in the full blast of the sun, the temperature must have been even higher than 158° which in itself is sufficient to kill young seedlings. The danger in such high temperatures has been proved by Baker (1) who found that surface temperatures of 130° F. quickly kill young coniferous seedlings. Toumey and Neethling (10) found that lesions occur on coniferous plants whenever the topsoil temperature exceeds 122° F. for a period of two hours, even if the roots are in contact with abundant soil moisture. Haig (4), studying seedling survival on the three Priest River areas, found surface soil temperature to be the most important single physical factor causing first-year seedling mortality on the clear-cut area.

Averages show that during July and August on the clear-cut area there were 44 days when the duff temperature exceeded 120° F., the average period of duration being over four hours each day. On 26 days the temperature was at least 130° for an average period of three hours, and on four days temperatures greater than 140° were

Table 2

SIGNIFICANCE OF THE DIFFERENCES BETWEEN THE MEANS OF THE CLEAR-CUT AND HALF-CUT AREAS, AND OF THE HALF-CUT AND FULL-TIMBERED AREAS

Factor measured	Difference between the means of the Clear-cut and half-cut areas		Half-cut and full-tbr. areas	
	Diff.	Std. Error	Diff.	Std. Error
Maximum air temperature, °F.	2.4	±0.1	2.4	±0.1
Soil temperature, 1-ft. depth, °F.	5.7	±0.1	2.5	±0.1
Maximum sur. duff temperature, °F.	35.3	±0.9	14.6	±0.6
Relative humidity, 4:30 p.m., per cent	1.7	±0.3	6.8	±0.4
Abso. humidity, 4:30 p.m., grs./cu. ft.	0.069	±0.022	0.457	±0.028
Wind movement during day, miles	13.8	±0.4	15.0	±0.5
Evaporation rate, grams	86.0	±7.0	37.0	±7.0
Duff moisture, per cent	8.3	±0.7	2.3	±0.4
Branchwood moisture, 2" diam., per cent	3.1	±0.1	1.6	±0.1

recorded for periods of two hours. Temperatures of this magnitude no doubt cause the death of young trees on planted areas and of reproduction on the more exposed sites, as well as tremendous mortality among young seedlings. Wahlenberg (11) studied the effect of the shade of ceanothus brush on ponderosa pine seedlings, but attributed the better survival of transplants under the bushes largely to more favorable moisture conditions. Often the beneficial effect of shade is realized in planting operations and young trees are placed in the shade of stumps and logs, and the wisdom of this practice is clearly shown by the present data. An outstanding example of the effect of the shade of some small object can be found in the Priest River records for August 5, 1930, when the shade of a fence post on the duff caused the temperature to drop from a fatal 142° to 122° in about 20 minutes.

In contrast to these dangerous conditions brought about by clear-cutting, only once in three years has the duff temperature on the half-cut area exceeded 120° F. and then it reached 122° F. for only a few minutes. The highest record of duff temperature on the full-timbered area was 94° F.

The effect of the timber canopy on fire danger, as shown by the moisture contents of duff and wood, is so obvious in Table 3 that it needs little comment here. By influencing temperature, humidity, wind, and evaporation the forest overwood makes moisture-holding conditions much more favorable and cuts down the inflammability, hence the danger from rapid spread of fire. A full forest cover eliminates 90 per cent of the critical days during July and August, while half cover cuts out more than one half.

Absolute humidity has been purposely omitted from the discussion so far. From Table 2 the half-cut average absolute humidity is shown to be just barely significantly different from the clear-cut value. The former area had an average of .069±.022 more grains of water per cubic foot of space than the open area. While in this case the small difference is real, conditions can be readily visualized, and actual records are available where absolute humidity under a timber canopy is the same as out in the open although *relative* humidities are higher and temperatures are lower in the timber. In this connection it is desirable to remember that relative humidity is the ratio of the amount of moisture in space to the amount that space could hold, temperature and pressure being constant. It is possible that the relative humidity under timber is greater because the temperature is lower, hence the *capacity* of space to hold moisture here is less. This observation is supported by Cummings (2), who states that "the direct effect of (relative) humidity changes on evaporation should not be confused with the indirect effect caused by changes in insolation which usually accompany humidity changes."

The importance of a timber cover in decreasing inflammability by lowering temperature and raising relative humidity is no doubt overemphasized. Applying the averages of Table 1 to the equilibrium relations between relative humidity and

TABLE 3

EXTREMES OF WEATHER AND INFLAMMABILITY DURING JULY AND AUGUST ON THREE SITES AT THE PRIEST RIVER FOREST EXPERIMENT STATION

	Clear-cut area	Half-cut area	Full-tbr. area
Highest duff temperature measured, °F.	158.0	122.0	94.0
Lowest duff moisture measured, per cent	3.5	8.0	8.5
Lowest 2" branchwood moisture measured, per cent	3.5	7.0	7.5
Average per cent of critical days (when duff moisture was below 10 per cent)	88.7	32.3	8.1

fuel moisture derived by Dunlap of the Forest Products Laboratory and reproduced by Gisborne (3), the lower temperature and higher humidity on the half-cut area accounted for a fuel moisture greater than the clear-cut moisture by only four-tenths of one per cent. The contribution of temperature and relative humidity to the greater fuel moistures that exist under forest canopies, therefore, may be relatively small in comparison to the effect of wind, sun, and other factors.

Summary

All of the observed differences, in the weather and inflammability, between the full-timbered, half-cut, and clear-cut areas were found, by making statistical tests of significance, to be real.

The influence of a forest cover as shown by the Priest River records benefits the survival of seedlings and planted stock by creating more favorable conditions of temperature.

Inflammability is greatly reduced under the canopy because of a lower evaporation rate. A full stand of timber eliminated 90 per cent of the critical days during July and August.

Absolute humidity is a better index of differences in atmospheric moisture on areas where the temperature is not the same. Relative humidity, when used alone, may be misleading.

Conclusions

Definite information on the requirements of tree species is somewhat meager at the present. However, to make use of the data now available it is necessary to have equally specific data on the physical factors of sites. The forester may strengthen the foundations of silviculture by recognizing the influence of stand density upon the weather under the canopy and by correlating it with the requirements of various tree species. He may well realize the important effect of varying canopy density upon inflammability and formulate his plans for successful fire control accordingly.

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Table 4

DAYS AND HOURS WHEN SURFACE DUFF TEMPERATURE EXCEEDS 120°, 130°, AND 140° F. ON THE CLEAR-CUT AREA

	Duff temperature above: 120°	130°	140°
Average number of days during July and August	44	26	4
Average number of hours	4.2	2.9	2.0

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To the man in the street most forms of scientific research are regarded as an expensive luxury, although there are occasional cases where a successful pioneer is given an unexpected share of limelight when his scientific toy has become the civilized world's latest necessity. . . . .

Until a healthy public opinion has been built up amongst the educated classes with an appreciation of the economics of plantation work and the replacement of felled crops, timber treatment and seasoning, the development of our minor forest products, and of forest protection in its widest sense, our research programme will remain at the mercy of whomsoever happens to hold the purse-strings of government.—*Indian Forester*, February, 1934.

OCCURRENCE AND PARASITISM OF ALEURODISCUS AMORPHUS IN NORTH AMERICA

By J. R. HANSBROUGH

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In December, 1930, Mr. Hansbrough found an area in the Mount Hood National Forest, Oregon, where the fungus, *Aleurodiscus amorphus* (Pers.) Rabenh,[2] was associated with a definite canker (Figure 1) on a high percentage of the stand of suppressed lowland white fir (*Abies grandis* Lindl.). The infection was so uniformly severe and the cankers were so conspicuous that a brief study of the occurrence and apparent parasitism of the fungus was considered advisable.

THE area is near the Zig Zag Ranger Station at the western boundary of the Forest, and approximately fifteen miles east of the village of Sandy, Oregon. The elevation is fifteen hundred feet. Second-growth Douglas fir [*Pseudotsuga taxifolia* (LaM.) Britt.] is the principal component of the stand with a scattered undergrowth of lowland white fir, western hemlock [*Tsuga heterophylla* (Raf.) Sarg.], and various shrubby hardwoods willow [(*Salix spp.*), red alder (*Alnus rubra* Bong.), maple (*Acer spp.*), etc.]. All of the conifers in the undergrowth are of the slow-growing, suppressed type. Apparently, because of root competition and insufficient light they are weakened to such an extent that they are highly susceptible to attack by parasitic diseases.

In such an environment one finds that certain fungi which are usually saprophytic become parasitic and invade living tissues. *Aleurodiscus amorphus* belongs in this category. On the Zig Zag area it is a weak facultative parasite, i. e., it is attacking only those white fir trees that are in a weakened condition and it continues to live as a saprophyte after the host tree is dead.

Description of the Disease

The fructifications of the fungus, *Aleurodiscus amorphus,* occur commonly on both cankered living bark and on dead adhering bark. They have the general aspect of a small Peziza and are in accord with the description of type material of this species as given by Burt (2).

The cankers are on stems that vary in diameter from one-half inch to four inches and they range in size from incipient ones just apparent up to those three inches wide by eighteen inches long. Their long axes follow the vertical axes of the trees. The largest canker found was on a tree twenty-five feet in height with a d.b.h. of three inches. This canker was twelve feet from the ground on the stem, and measured two and one-half inches by eighteen inches.

All cankers are narrowly eliptical in outline and are delimited by a definite raised border, which is particularly noticeable when contrasted with the sunken center (Figure 1). Within the cankered area, the cortex and cambium are soon killed and the bark usually becomes cracked and occasionally shredded.

Microscopic examination of sapwood just beneath the diseased bark has shown that there is very slight penetration beneath the cambium by the fungous mycelium.

In the center of each canker is a dead branch stub, suggesting that the mode of

[1]In coöperation with the Northeastern Forest Experiment Station. Maintained by the U. S. Department of Agriculture at New Haven, Connecticut, in coöperation with Yale University.
[2]The writer's identification of this fungus was verified by J. A. Stevenson, Senior Mycologist, U. S. Department of Agriculture.

infection by the fungus is through saprophytic growth in the dead branch until entrance into the stem is obtained. Then the fungus spreads in the living bark and causes the formation of typical cankers. This supposition is further strengthened by the fact that the fruiting bodies of *Aleurodiscus amorphus* are generally abundant on the dead branch which is at the center of the canker. No canker has ever been found centered around a living side branch. On the Zig Zag area no living side branch was ever found to be infected. In fact, only one instance of parasitism on any part of the tree other than the stem has come to the writer's attention, and that was a branch canker (F. P. 53850)[3] on the southern balsam fir [*Abies fraseri* (Pursh) Poir.] planted in Hamilton, Massachusetts, far out of its native range.

Detailed Infection Data

In the spring of 1932 a tenth-acre plot was laid out in the heavy infection center in the Mt. Hood National Forest. Of the total of 171 trees and saplings in the plot, 119 were lowland white firs. Fifty-five of these trees, or 46 per cent, were diseased by the fungus and had typical stem cankers (Figure 1). A total of 86 cankers were present on the diseased trees, the maximum number on one tree being 5. Twelve of the diseased trees, or 22 per cent, were dead whereas only 4 of the uninfected trees, or 6 per cent, were dead. The greater proportion of infected dead trees as compared with those not infected indicates that the mortality in the stand has been higher than would normally occur from suppression and that the fungus is responsible for the additional dying.

Distribution and Hosts in North America

Aleurodiscus amorphus is apparently indigenous in North America as well as in Europe. Certainly its wide-spread occurrence on both continents lends credence to such an assumption. The balsam firs (*Abies spp.*) are favorite hosts for the fungus but it has in addition been collected in North America on the following genera of coniferous trees: Thuja (2, 23, 26), Larix (23), Picea (2, 4, 23, 26), Tsuga (17, 23, 26), Pseudotsuga and Pinus. In this paper collections on the two latter genera are reported for the first time on this continent.

Fig. 1.—Typical canker on lowland white fir in Mt. Hood National Forest, Oregon.

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[3]The letters F. P. followed by a number refer to a specimen in the herbarium of the Division of Forest Pathology bearing the number mentioned.

The complete list of host species within these seven genera is as follows: Abies balsamea (L.) Mill., *A. concolor* Lindl. & Gard., *A. lasiocarpa* (Hook.) Nutt., *A. grandis* Lindl., *A. nobilis* Lindl., *A. amabilis* (Loud.) Forbes, *A. fraseri* (Pursh) Poir., *Larix laricina* (Du Roi) Koch, *L. occidentalis* Nutt., *Picea mariana* (Mill.) Br. St., & Pog., *P. engelmannii* Engelm., *P. sitchensis* (Bong.) Carr., *Pinus strobus* L., *Pseudotsuga taxifolia* (LaM.) Br., *Thuja plicata* D. Don., *Tsuga canadensis* (L.) Carr.

Abies lasiocarpa and *Larix laricina* are reported as hosts for this fungus by Seymour (23) but the writer has been unable to determine the exact sources of his information. Collections on both species are herein listed but they are not regarded as new hosts.

The known or reported distribution of this fungus in North America is given below. Literature references are given whenever possible along with the name of the collector and the herbarium in which the specimen is preserved.

The writer is indebted to the following institutions for information concerning, and access to, their herbaria: Farlow Herb.; Field Mus. Nat. Hist.; N. Y. Bot. Gard.; N. Y. State Mus.; Mo. Bot. Gard.; Cent. Exp't Farm, Ottawa; and Pathological Collections, U. S. Dept. Agri. In addition he wishes to express his appreciation to the following scientists for their assistance in accumulating the distribution records given below: P. Spaulding, J. A. Stevenson, C. W. Dodge, F. J. Seaver, H. D. House, Irene Mounce, J. Dearness, L. O. Overholts, S. M. Zeller, L. N. Goodding, J. S. Boyce, J. W. Hotson and J. Ehrlich.

Canada

Newfoundland.—Abies balsamea: Bitten Bay (Waghorne 30—in N. Y. St. Mus. herb.). *Abies sp.:* (?) Quin Wash (Waghorne 426—in N. Y. Bot. Gard. herb.). *Abies sp.**[4]: Frenchman's Cove (Waghorne 11—in N. Y. St. Mus. herb.); Perivase River (Waghorne 12—in N. Y. St. Mus. herb.); Exploits River (Waghorne 23—in N. Y. St. Mus. Herb.)?; Topsail (Waghorne 29—in N. Y. St. Mus. herb.).

Prince Edward Island.—Host unknown—Rustico Bay (Macoun 342) (2)

Nova Scotia.—Abies balsamea: Scottsville, Inverness County (Ehrlich herb. 803—F. P. 53089) associated with cankers on suppressed trees.

New Brunswick—Abies balsamea: Point Wolf, on Bay of Fundy (Ehrlich herb. 845). *Abies sp:* Ingleside (Hay 13—in Path. Colls.) (7).

Quebec—Abies balsamea: Lac Brule (Gordon—in Dearness herb.; Gardner—F. 1386 in Cent. Exp't Farm herb.); Merrifields Corners (Connors—F. 1622 in Cent. Exp't Farm herb.); Mt. Burnet, Gatineau Hills (Güssow—F. 2736 in Cent. Exp't Farm herb.). *Pinus strobus:*[5] Upper Lachute (Gordon—in Dearness herb.).

Ontario—Abies balsamea: Bear Is., Lake Timagami (Connors—F. 1452 in Cent. Exp't Farm herb.; 13484 in Overholts herb.). **Abies sp:* Ottawa (Macoun 87—in N. Y. St. Mus. herb.); Lake Nipigon (Macoun 199—in N. Y. Bot. Gard. herb.) Bark-Kenora (1, p. 88).

Manitoba—Bark—Winnipeg (1, p. 88) (Overholts herb. 6149). Host unknown—Wooded country from latitude 54° to 64° North (6, p. 763). This would fall in northern Manitoba, Northern Saskat-

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[4]Asterik indicates that host was determined by writer.

[5]This host determination rests solely on the collector. It is not at all improbable, however, because Saccardo (22) lists *Pinus cembra* L., one of the Asiatic five-needle pine species, as a host for this fungus in Asiatic Siberia.

chewan, or southern District of McKenzie —probably the first.

British Columbia.—Pseudotsuga taxifolia: Vancouver Is. (Macoun—three unnumbered collections in Dearness herb.). Conifer—Nanaimo (Bisby—in Dearness herb.); Sidney (Macoun 29, 31—in Mo. Bot. Gard. herb., 6773 and 6774 respectively); Vancouver (Macoun—Path. Colls.); locality unknown (Macoun 346 —Path. Colls.).

United States

Maine—Abies balsamea: Ocean Point (Fassett 354—in Path. Colls.); Locality unknown (Path. Colls.); Pea Cove (21) (Ricker in N. Y. Bot. Gard. herb.); Mt. Desert Is. (F. P. 53775, 53807, and 53852) third collection associated with cankers on suppressed trees. Host unknown—Cumberland (21).

New Hampshire.—Abies balsamea: Shelburne—(Farlow—Farlow Herb., Mo. Bot. Gard. herb. 4772; Schrenk—Mo. Bot. Gard. herb. 4811); White Mts. (5); Crawford Notch (14) (Overholts herb. 4840); Willey Station (Overholts herb. 9759); Keene (F. P. 16384); Marlow (F. P. 16338); Carter Dome Trail (F. P. 45623); Carroll (F. P. 55842); Littleton (F. P. 55843) associated with cankers on suppressed saplings; Bethlehem (F. P. 51728, 55845) latter collection associated with cankers on suppressed trees. *Abies sp:* King's Ravine, Mt. Adams (Farlow Herb.); *Chocorua (Farlow Herb.). *Picea sp:* Camp, Ellis R. (Underwood—in N. Y. Bot. Gard. herb 2114—in Mo. Bot. Gard. herb. 4773). *Tsuga canadensis*—Waterville (F. P. 55844).

Vermont—Abies balsamea: Belmont (Boyce herb. 2071) associated with cankers on suppressed trees; Waterford (F. P. 16820). Host unknown—Newfane (Hibbard 9—in Path. Colls.).

Massachusetts.—Abies fraseri: Hamilton (F. P. 53850) associated with canker on branch of living tree. **Abies sp.*—Newton (Farlow herb.). *Picea sp.*—Newton (4) (Farlow herb., Mo. Bot. Gard. herb. 55576). *Pseudotsuga taxifolia*—Ipswich (F. P. 16769).

Connecticut—Abies balsamea: Goshen F. P. 56269.

New York—Abies balsamea: Lake Placid (Murrill 209, 1127—in N. Y. Bot. Gard. herb.); E. Galway (Burt—Farlow herb.); Newcomb (F. P. 51437; Welch—in Dearness herb.); Titus Lake (F. P. 55847) associated with cankers on suppressed trees; Cohasset, Fourth Lake (House 6114—in N. Y. St. Mus. herb.); Tupper Lake (Overholts herb. 9390); Remsen (Peck 1376—in N. Y. St. Mus. herb.); North Elba (11, 18) (Peck—in N. Y. St. Mus. herb.); Buffalo (16); Locality unknown (17); Speculator (House—in N. Y. St. Mus. herb.; in Mo. Bot. Gard. herb. 59707); Seventh Lake (26) (Stork—in Mo. Bot. Gard. herb. 56638). **Abies sp:* Indian Lake (15) (Peck—in N. Y. St. Mus. herb.); Sand Lake (Peck—in N. Y. St. Mus. herb.); Syracuse (Underwood 82—in Mo. Bot. Gard. herb. 61582; in N. Y .Bot. Gard. herb.) *Abies sp.* or *Picea sp:* Mountain Jct. (Clark—in N. Y. Bot. Gard. herb.). *Picea mariana:* Newcomb (F. P. 55846). *Picea sp:* Warrensburg (Shear—in Path. Colls.); Cranberry Lake (Povah—in N. Y. St. Mus. herb.). *Tsuga canadensis*—Locality unknown (17). Host unknown —Willsboro (2).

Michigan—Abies balsamea: Vermilion (12, 20); Sailor's Encampment (Harper 539— in Field Mus. Nat. Hist. herb.); Neebish (Harper 1014—in Field Mus. Nat. Hist. herb.).

Minnesota—Larix laricina: Vermilion Lake (Holway—in N. Y. Bot. Gard. herb.).

Missouri—Abies sp: St. Louis (Zeller herb. 661).

*Wisconsin—*Abies sp:* Madison (stucki 55—Farlow herb.).

Colorado—Picea sp: Wild Basin (Shope—in Overholts herb. 11223).

Washington—Abies amabilis: Chehalis (Humphrey 5276—in Farlow herb.); Olympic Mts. (2) (Frye 18—in N. Y. Bot. Gard. herb., 43—in Farlow herb., in Mo. Bot. Gard. herb. 44301). *Abies grandis:* Camas (F. P. 40902). *Abies sp:* Mt. Rainier Nat. Park (F. P. 53853). **Abies sp:* Seattle (Parker 136—in Univ. of Wash. herb.; in Farlow herb.). Host unknown—Sequim (Grant 67—in Path. Colls. 34016); Paradise Valley (Harper 1194—in Field Mus. Nat. Hist. herb.); Friday Harbor (Harper—in Field Mus. Nat. Hist. herb.).

Montana—Abies lasiocarpa: Haugan (Weir herb. 16785—in Path. Colls.); Bullian (Weir herb. 17233—in Path. Colls.).

Idaho—Abies concolor:[6] Pend Oreille (Ellis & Everhart N. Am. Fungi 2733). *Abies grandis* Clarkia (F. P. 40895); Long Meadow Creek (F. P. 40896); Coolin (Weir herb. 16767—in Path. Colls.); Burke (Weir herb. 17221—in Path. Colls.). *Abies lasiocarpa:* Priest River (Weir herb, 311, 358—in Path. Colls.); Addie (Weir herb. 11923, 12676—in Path. Colls.); St. Joe Nat. Forest (Weir herb. 16784—in Path. Colls.). *Abies sp:* Clearwater Nat. Forest (Weir herb. 16758—in Path. Colls.). *Larix occidentalis:* Priest River (Weir herb. 607—in Path. Colls.). *Picea engelmannii:* Addie (Weir herb. 11682, 11918—in Path. Colls.). *Pseudotsuga taxifolia:* Bovill (Weir herb. 17207—in Path Colls.).

Oregon—Abies amabilis: Horsethief Meadows (F. P. 40898); Pamelia Lake (F. P. 40897). *Abies lasiocarpa:* Government Camp (F. P. 40899). *Abies nobilis:* Bennett Pass (F. P. 40692). *Abies grandis:* Linnton (F. P. 40901); Corvallis (28) (Zeller herb. 695, 1722, 1791, 2267); Kingston (F. P. 40840) associated with cankers on suppressed trees; Oregon City (F. P. 40900) associated with cankers on suppressed trees; Zig Zag Ranger Station, Mt. Hood Nat. For. (F. P. 40601) associated with cankers on suppressed trees. **Abies sp:* Forest Grove (2) Sweetser—in Farlow herb.). *Picea sitchensis:* Taft (F. P. 40860). *Pseudotsuga taxifolia:* Portland (R. P. 40903); Wren (Zeller herb. 7835). *Thuja plicata:* Mt. Hood (Frye 15—in Mo. Bot. Gard. herb. 55444, in N. Y. Bot. Gard. herb.).

California—Abies concolor: Massack (Rhoads 19—in Mo. Bot. Gard. herb. 56988).

These distribution data show that though *Aleurodiscus amorphus* occurs on a wide range of hosts over a large portion of the North American continent, it is relatively restricted in its parasitic activities. Up to the present time the only heavy infection area known is that described in this paper, i. e., in the Mt. Hood National Forest, Oregon. The other localities where it has been found associated with cankers are as follows: Scottsville, N. S.; Mt. Desert Is., Me.; Littleton and Bethlehem, N. H.; Belmont, Vt.; Hamilton, Mass.; Titus Lake, N. Y.; and Kingston and Oregon City, Ore. Hubert (10, p. 298) states that this fungus is common on coniferous twigs and branches but is primarily a saprophyte. This statement is borne out by the writer's observations and by the data accompanying the herbarium specimens listed.

Discussion of and Comparison with Disease in Europe

Aleurodiscus amorphus has long been known in Europe (22) as a weak parasite on the European silver fir (*Abies pectinata* De Cand.). In the last few years its occurrence on this fir in Germany in

[6]The white fir in northern Idaho is now considered to be *A. grandis* and, if this collection were made today, the host would probably be that instead of *A. concolor.*

association with other organisms has given rise to what Falck (3) called a chain disease. He studied the disease and found that the trees were primarily attacked by *Chermes* spp., then by the sooty mold, *Antennaria pithyophila* Nees., and the two bark fungi, *Dasyscypha calyciformis* (Willd.) Rehm and *A. amorphus.* He frequently observed root and collar infection of the diseased trees by the root fungus, *Armillaria mellea* (Vahl.) Quel., but considered this as something to be expected under ordinary conditions and did not include it as a member of the chain. Wiedemann (27) studied the disease at the same time and decided that the insect injury was the primary source and that the various fungi found on the diseased trees were, in reality, secondary and often saprophytic in occurrence. Plassmann (19) was even more opposed to Falck's theory and stated that his observations showed the fungi to be saprophytes in every case examined. He, therefore, assumed that Chermes infestation was the sole cause of the trouble.

Regardless of the relation that *Aleurodiscus amorphus* bears to the disease of silver fir in Europe, there can be little doubt that in North America it is occasionally associated with a very definite canker disease of suppressed balsam firs (*Abies spp.*), and that it is capable of causing this diseased condition without the assistance of other organisms.

Hanzlik (8, pp. 105-111; 9) shows that the balsam firs of the Northwest respond rapidly when opened up to light and freed of root competition. Quoting him (9), "Trees growing suppressed for from 70 to 100 years and only from 2 to 3 inches in diameter and 10 to 15 feet tall, show an exceedingly good pick-up, and after a few years have the appearance of young trees above the height they had at the time of liberation."

From one point of view it would appear that a disease such as this one caused by *Aleurodiscus amorphus* is causing damage to the forest of the future. It apparently increases the rotation period just so many years as it will take for new reproduction to reach the size that these suppressed trees would have at the time they were opened up to light and freed of root competition by logging operations. Actually, however, there is damage only if the disease interferes with the ultimate stocking of the future merchantable stand (13, 24, 25). Studies were not made to determine whether this disease is capable of causing such damage or whether its action is as a whole advantageous to the forest through beneficial thinnings. However, diseases of this type are generally regarded as probably being more beneficial than detrimental.

Summary

The fungus, *Aleurodiscus amorphus,* was found in association with definite cankers on the lowland white fir (*Abies grandis*) on an area in the Mt. Hood National Forest in Oregon. Detailed infection data on a tenth-acre plot are given.

The distribution of the fungus in North America is given along with notes on the localities where cankers have been found in association with it. Two new genera (Pseudotsuga and Pinus) and ten new species (*Abies grandis, A. nobilis, A. amabilis, A. fraseri, Larix occidentalis, Picea engelmannii, P. mariana, P. sitchensis, Pinus strobus,* and *Pseudotsuga taxifolia*) are reported as hosts for the first time in North American literature.

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INITIAL ROOT DEVELOPMENT OF LONGLEAF PINE

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THE establishment and early development of tree seedlings is limited by the ability of the seedlings to obtain water and feed. These seedlings whose roots fail to adapt themselves to their environment so that they can secure food and water usually die relatively soon after germination.

The ability of longleaf pine [*Pinus palustris* (Miller)] to become established on dry sand ridges where few other species are able to survive suggests that the initial root habit of the species might play an important rôle. This study was initiated to obtain more definite information on early root growth and the initial root habit of this species and its flexibility.

There are few publications relative to the subject of initial root development of forest trees. Professor James W. Toumey (1, 2, 3) made studies of the initial root habits of nearly 100 species, particularly those indigenous to the northeastern United States. His conclusions from this study were: "1. Initial root systems in form and habit of growth are characteristic of each species and are closely correlated with the particular site conditions under which the species naturally grows; and 2, the initial root habit of the species examined varied greatly in their inherent tendency to change under variations in external conditions."

Methods and Results of Present Study

In this study of the early root growth and the initial root habit of longleaf pine the only variables considered were the soil type of the seed beds and the amount of available moisture. All other factors were kept as nearly the same as possible, the seedlings being grown in flats side by side in a greenhouse. The seed used in this study were gathered in Brunswick County, North Carolina.

Two types of soil were used, namely, clay and coarse sand. Moisture was varied in the extremes. The wet seedling flats were watered daily until surface water accumulated, while the dry flats were watered only every eighteen days. The seed beds used in the study included: a wet flat of sand, a dry flat of sand, a wet flat of clay and a dry flat of clay. All flats received an equal amount of moisture until after the majority of the seeds in each flat had germinated. There was no marked difference as to the rate of germination of seeds in the various flats. All seeds were sown at the same time.

After seed germination root measurements were taken at the end of each month for a period of five months. At each root examination from 10 to 20 seedlings were carefully removed for root measurement from each of the four flats.

In addition to the study of root systems by removing seedlings for measurement, root development was traced for a period of four months after germination by direct examination in which the roots were not disturbed or removed from the soil. This was accomplished by observing seedlings growing in boxes having glass fronts. These glass fronts sloped in so that the roots, after descending a short distance to the glass, could be seen growing downward. These observations were made from boxes in which only one soil type was used, namely, coarse sand. One box was watered daily, the other every

eighteen days. Light was excluded from the roots by a heavy covering of burlap.

Examination of the data (Tables 1, 2, 3) shows that a faster rate of depth growth, on the part of main root stems, was induced in the sand soil by thecomparative absence of moisture. The lateral roots in no instances, during the five-month period of measurement, approached the length of main root stems. Very few lateral roots became branched during that period. For all conditions employed the main root development was emphasized over lateral root growth. In fact, until the end of the fourth week the entire root system under all conditions employed consisted of a solitary main root. At that period lateral root development began in the form of minute swellings along the entire length of the root stems.

Longer lateral roots developed in the wet soils. However the general root form remained the same. A greater number of lateral roots developed in dry sand than developed in wet sand. This might be explained by the fact that because dry sand seedlings developed longer main roots an opportunity for a greater number of laterals was afforded.

In contrast to the greater depth growth for roots in dry sand over roots in wet sand, the seedling roots taken from the wet clay showed greater depth growth than did seedlings taken from dry clay. With this fact it is important to consider the difference in soil structure as effected by the moisture applied. The sand flats, both wet and dry, were at all times readily penetrable in following the root systems in making removals for measurement. This was also the case in measuring seedling roots in the wet clay. The soil lay loosely about the roots in all flats except in the dry clay flat. In this flat the soil became extremely hard. It was difficult to remove the root systems

TABLE 1

MEASUREMENTS OF ROOTS WHICH DEVELOPED IN SEED BEDS OF COARSE SAND

Period	2nd month		3rd month		4th month		5th month	
Moisture	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Number of root systems measured	14	15	13	17	15	11	12	17
Average length main root in inches	7.7	5.3	8.8	6.8	9.5	7.4	11.5	8.9
Average number lateral roots per main root	34	53	63	54	54	47	87	77
Average length of laterals in inches	.1—	.15	.1—	.28	.14	.29	.10	3
Length of longest lateral for systems examined—inches	.7	1.0	.9	1.0	.7	1.0	.9	2.0

TABLE 2

MEASUREMENTS OF ROOTS WHICH DEVELOPED IN SEED BEDS OF CLAY

Period	2nd month		3rd month		4th month		5th month	
Moisture	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Number of root systems examined	14	23	16	17	14	14	12	11
Average length main root in inches	5.0	6.3	5.6	6.6	6.8	7.2	7.1	7.5
Average number lateral roots per main stem	19	34	26	36	39	29	37	40
Average length of laterals in inches	.1	.29	.15	.29	.13	.40	.16	.56
Length of longest lateral for systems examined	.4	1.0	.7	2.2	.5	2.1	.7	3.2

TABLE 3

MEASUREMENTS OF ROOT SYSTEMS WHICH DEVELOPED IN COARSE SAND IN BOXES HAVING GLASS FRONTS AFFORDING OPPORTUNITY FOR DIRECT MEASUREMENT WITH SEEDLING REMOVAL

Period	1st month		2nd month		3rd month		4th month	
Moisture	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Number of root systems examined	28	22	25	18	21	15	21	15
Total length main roots stem-average in inches	3.3	3.8	6.1	5.0	8.2	6.5	12.6	7.7

from the hard masses which bound the roots.

There was practically no difference in the appearance of seedling tops in wet sand, dry sand, and wet clay. The above ground parts of seedlings grown in these flats were characterized by dense clumps of long, primary needles of a healthy green color. Seedlings grown in the dry clay flat showed sparse needle development. Primary needles were comparatively short and of a light green to yellowish in color. Casualties in the dry clay were also common.

CONCLUSIONS

The initial root system of longleaf pine consists of a single, long, primary root with comparatively short, unbranched lateral roots which vary in length and number with the soil type in which they grow and with the amount of available moisture.

The form of the initial root system of longleaf pine did not vary with changes in soil texture or moisture conditions. The seedlings of this species were deep rooted in both sand and clay and when exposed to little or an abundance of moisture.

The rate of depth growth, in the initial rooting of longleaf pine, was dependent upon the amount of moisture available in seed beds of sand. Primary root systems in dry sand developed to a greater depth, in the same period of time, than did root systems in wet sand.

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FIRE RESISTANCE IN THE FOREST

By T. J. STARKER

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A rating scale of the resistance to fire would be helpful knowledge in the management of a forest in any region. The author has combined his wide knowledge of conditions with the best available information in the various regions of the United States. A comparison is made in regard to the development of scales of tolerance and of fire resistance. The need for more detailed and accurate knowledge is pointed out.

IF FORESTERS were given an opportunity to rate their regions and tree species with reference to low fire risk and fire resistance, how many would pick the California fog belt with redwood as the species? The fact that a tree can grow to an age of 1,000 to 4,000 years is fairly good testimony that that tree can resist fire, insects, and fungi, or that it has not been exposed to these dangers. Even though many foresters, on this basis, would pick the redwoods as the supreme fire resistant tree, let us examine briefly, what Fritz (1) has to say on the subject:

"Normally, it is difficult to start a fire in the virgin redwood forests except with some preparation.

"Trees of great age—over 1,000 years—are often sound to the heart and show only a few fire scars. Doubtless such specimens owe their long life and freedom from more frequent injury to a combination of chance and a particularly thick, dense and resistant layer of bark.

"The virgin redwood forest has been irreparably damaged by past fires; current fires aggravate the damage and on cut-over land they materially reduce its ability to produce new tree growth."

Without question, fire has caused a decrease in the density of the stand, and in increment. The formation of "goosepens," spike tops, and 90 to 100 per cent of the decay at the base of the trees is also due to fire.

Thus, if fire has played havoc with such a resistant species as redwood, would it not be well for foresters to rate the trees of their region as regards resistance to fire? But this has apparently not been done except in isolated cases, as little literature appears on the subject, and correspondence does not bring out a great deal of authentic data.

Northern Rocky Mountain Region

From general observation and tree counts on fire trespass surveys, Howard Flint (2) compiled the data shown in Table 1.

Table 1 was published in 1925. It is one of the first systematic attempts to arrange the species in a given region in order of their fire resistance.

On two typical white pine areas burned in August, 1926, on the Kaniksu National Forest, Mr. I. T. Haig (3) compiled Table 2.

From Table 2 a fire resistance table could be arranged as follows:

Arranged in order of fire resistance (Most resistant first)	Per cent of total still alive five years after fire
Western larch	87
Douglas fir	51
Western red cedar	21
Lowland white fir	18
Western white pine	16
Englemann spruce	12
Western hemlock	10
Lodgepole pine	9
Alpine fir	0

It will be noted from the above that this list changes the order of species from that given by Mr. Flint. This table, how-

TABLE 1

SHOWING THE RELATIVE FIRE RESISTANCE OF THE MORE SILVICULTURALLY IMPORTANT NORTHERN ROCKY MOUNTAIN CONIFERS

Species	Thickness of bark old trees	Root habit	Resin in old bark	Tolerance		Relative inflammability of foliage	Lichen growth	Degree of fire resistance
				Branch habit	Stand habit			
Larix occidentalis	Very thick	Deep	Very little	High and very open	Open	Low	Medium heavy	Most resistant
Pinus ponderosa	Very thick	Deep	Abundant	Moderately high and open	Open	Medium	Medium to light	Very resistant
Pseudotsuga taxifolia	Very thick	Deep	Moderate	Moderately low and dense	Moderate to dense	High	Heavy to medium	Very resistant
Abies grandis	Thick	Shallow	Very little	Low and dense	Dense	High	Heavy	Medium
Pinus contorta	Very thin	Deep	Abundant	Moderately high and open	Open	Medium	Light	Medium
Pinus monticola	Medium	Medium	Abundant	High and dense	Dense	Medium	Heavy	Medium
Thuya plicata	Thin	Shallow	Very little	Moderately Low and dense	Dense	High	Heavy	Medium
Picea engelmanni	Thin	Shallow	Moderate	Low and dense	Dense	Medium	Heavy	Low
Tsuga mertensiana	Medium	Medium	Very little	Low and dense	Dense	High	Medium to heavy	Low
Tsuga heterophylla	Medium	Shallow	Very little	Low & dense	Dense	High	Heavy	Low
Abies lasiocarpa	Very thin	Shallow	Moderate	Very low and dense	Moderate to dense	High	Medium to heavy	Very low

ever, is based on two plots only. Mr. Flint's table is the result of observations made in a broader field. Mr. Haig says, "The values look reasonable to us for all of the species for which a good tree basis is available, with the possible exception of western red cedar. It is believed that this species is somewhat out of line, as almost all western red cedar on the areas covered, occurred in wet bottoms where it was protected by site conditions to a greater extent than the other tree species listed."

It is to be noted that Mr. Flint and Mr. Haig agree on the most resistant and least resistant species, which is a sign of progress. The fact that there is some variance in the central portion of the list merely points out the difficulties of forming an exact rating scale.

Pacific Northwest

In the Pacific Northwest, the Cascade Mountains separate two vastly different regions, climatically. Douglas fir is the outstanding species of the western part, while ponderosa pine is the principal commercial species east of the divide. Both of these trees, however, appear on each side, together with most of their associates. A tentative list (Table 3) was arranged in collaboration with W. B. Osborne, Jr., Inspector, U. S. Forest Service for this region.

Northeastern United States

In an attempt to determine relative fire resistance in the Northeastern United States, a questionnaire was mailed to 48 of the leading foresters of this region, and 41 replies were received. These data are almost entirely of an empirical character, and therefore open to much criticism. The region is one of many species, various sites, and with the fire hazard ranging from low to high. Table 4 lists the resistance as tabulated from these replies. In tabulating these replies, a striking correlation was evident, particularly in the extremes of the table. Few items were discarded, the highest being four for one species and there being none for twelve species. The limit for discarding was twice the standard deviation.

In two cases, the collection of accurate data helps to bear out the accuracy of the table which is based on observations.

Data collected by O. M. Wood of the Allegheny Forest Experiment Station (Table 5) on a number of trees give some accurate information for that region.

In a study of bark thickness by A. C. McIntyre of the Pennsylvania State College on 1,163 oak trees from 2-inch to 20-inch in diameter, he found that chestnut oak had the thickest bark, followed by black oak, red oak, scarlet oak and white oak.

Table 2

TREES KILLED OR DYING FROM FIRE INJURY WITHIN 5 YEARS OF DATE OF BURN

Species	Original stand	1926 and 1927	—Percentage of trees dying by years— 1928	1929	1930	1931	5-yr. Total
W. wh. pine	881	59.5	13.9	8.9	0.65	1.3	84.2
W. larch	70	1.7	1.4	6.9	----	2.7	12.7
White fir	166	44.0	11.2	22.4	4.8	----	82.4
Douglas fir	100	43.0	-----	3.0	1.5	1.5	49.0
W. hemlock	574	66.5	5.9	9.3	4.6	3.8	90.1
W. red cedar	185	73.0	3.3	1.6	—	0.84	78.7
Englemann spruce	49	49.0	31.4	3.9	----	3.9	88.2
Alpine fir	175	53.7	30.9	15.4	----	----	100.0
Lodgepole pine	18	5.6	60.0	17.2	—	8.5	91.3

Southwestern District

In correspondence (6) with the Southwestern District it developed that only a little work had been done on the subject of fire resistance of trees. The following would probably be the correct order: Pinus apacheca (Arizona long-leaf pine); Pinus ponderosa (Ponderosa pine); Pseudotsuga taxifolia (Douglas fir); Abies concolor (White fir) and Picea engelmannii (Engelmann spruce).

California Pine Region

Show and Kotok (7) say: "Like burning down, heat killing affects some species more than others. Yellow pine is the most resistant, followed by sugar pine, white fir and incense cedar, substantially in the same order as for burning down.

"Heat killing is naturally most common and destructive in stands on the poorer quality forest lands, for it is on such soils that the timber is shortest and the crowns more exposed to the intense heat.

Table 3

RELATIVE FIRE RESISTANCE OF THE MOST IMPORTANT TREES OF OREGON AND WASHINGTON IN ORDER OF GREATEST RESISTANCE

Species	Thickness of bark old trees	Root	Branch habit	Canopy cover	Lichen growth	Foliage inflammability	Most common method of killing
Western larch	Very thick	Deep	High and very open	Open	Black-light	Low	Most resistant
Douglas fir	Very thick	Deep	High dense	Dense	0 to heavy grey	High	Crown fires
Yellow pine	Thick	Deep	Mod. high and open	Open	Light-black	Low	Crown fires
White firs concolor and grandis	Moderately thick	Shallow	Low and dense	Dense	0-heavy grey	Med.	Root charring and crown fires
Western red cedar (sensitive but tenacious)	Thin	Shallow	Low and dense	Dense	0 to moder. grey	High	Root charring, crown fires and burning down
Mountain hemlock	Medium	Medium low	Low and dense	Dense	0 to moder. grey	High	Root charring and crown fires
Noble fir	Moderately thick	Medium	High and dense	Dense	Med. to heavy grey	High	Scorching of foliage or crowning and core burning
White pine	Medium	Medium	High and moderate	Dense	Moder. grey	Med.	Scorching cambium or crowning
Lodgepole pine	Very thin	Deep	Moderate low and open	Open	Moder. heavy grey and black	Med. low	Scorching cambium or crowning
Western hemlock	Medium	Shallow	Moderate low and dense	Dense	0-heavy grey	High	Root charring, crown fires and core burning
Engelmann spruce	Very thin	Shallow	Low and dense	Dense	0-heavy grey and black	Very high	Root charring, scorching cambium and crowning
Sitka spruce	Very thin	Very shallow	Moderate high and dense	Dense	0 to heavy grey and yellow	High	Root charring, occasional crowning

TABLE 4

RELATIVE FIRE RESISTANCE OF 40 TO 80 YEAR-OLD TREES OF NORTHEASTERN UNITED STATES

(Arranged in order of resistance)

1. Pitch pine	Pinus rigida
2. Chestnut oak	Quercus montana
3. Norway pine	Pinus resinosa
4. Black oak	Quercus velutina
5. White oak	Quercus alba
6. Scarlet oak	Quercus coccinea
7. N. white pine	Pinus strobus
8. Eastern hemlock	Tsuga canadensis
9. Sugar maple	Acer saccharum
10. Red maple	Acer rubrum
11. Tamarack	Larix laricina
12. Yellow birch	Betula lutea
13. Red spruce	Picea rubra
14. Black cherry	Prunus serotina
15. Norway spruce	Picea excelsa
16. Gray birch	Betula populifolia
17. Paper birch	Betula papyrifera
18. Aspen	Populus tremuloides
19. White spruce	Picea glauca
20. E. red cedar	Juniperus virginiana
21. N. white cedar	Thuja occidentalis
22. Balsam fir	Abies balsamea

Unfortunately, it is on just such soils that the struggle of the forest to maintain itself is most severe."

THE SOUTHEAST REGION

There is no question that longleaf pine (*Pinus palustris*), is the most fire resistant species in this region. In most regions, it is agreed that fire is a detrimental agency in the forest, but in the Southeast two controversial schools of thought have arisen on the value of fire. One maintains, through many years of experience and sample plot observations to back up its judgment, that fire is beneficial. This is based on the fact that fire helps to free the young longleaf from grass competition and helps to control a needle disease.

The other school of thought maintains that fire is harmful and has sample plots to back up its assertion. Photos of these areas seem to prove their point. It has been developed recently that longleaf may persist as a bud, protected by its long needles, for a period up to fifteen years. The writer is informed that the experiment station of the region is working on the subject of relative fire resistance of the indigenous species.

APPALACHIAN REGION

In a study carried on by the Appalachian Forest Experiment Station on 350 trees varying from 4 to 28 inches d.b.h. an attempt was made to correlate discoloration of the exterior bark caused by fire to the death of the cambium. The five species examined varied considerably in their relative susceptibility to wounding. Yellow poplar was the most resistant; chestnut oak, white oak and black oak were intermediate; and scarlet oak was most susceptible. It was found that scarlet oak is so low in resistance that the inner bark is killed sometimes for 20 feet above the highest point of discoloration of the exterior bark. The bark of this species is comparatively smooth and as thick as some of the more resistant species but, apparently, is a better conductor of heat.

Nelson (8) says, "Measurements of bark thickness made at six inches above the ground on the different species and diameters indicate that chestnut oak and yellow poplar have the thickest bark, scarlet and black oak are intermediate and white oak has the thinnest bark. Yellow poplar has an extremely thick layer of phloem which makes for good insulation. White oak bark is soft and flaky; whereas black and chestnut oak bark is hard and firm."

CONCLUSION

Unquestionably the problem of rating trees in the order of their resistance to

TABLE 5

TREES 6 INCHES AND OVER, KILLED IN ELEVEN JERSEY DAMAGE PLOTS OF 1930

	Killed No.	Killed Per cent	Total No. of trees
1. Shortleaf pine	8	18.2	44
2. Pitch pine	29	27.1	107
3. Chestnut oak	7	53.8	13
4. White oak	52	56.5	92
5. Scarlet oak	43	62.2	68
6. Black oak	7	100.0	7

fire, is very complicated. Many regions have a great variety of species growing on vastly different sites. Trees of different ages, when of the same species, vary in their resistance. Fire damage is affected by the season of burning (9). All these factors multiply the difficulty of making a rating scale. Yet is not fire resistance one of the tools with which the forester must work? A knowledge of tolerance is important, yet a scale of tolerance varies widely, depending on whether it is taken on a good site or a poor one, or if built up in the southern or northern part of a tree's range. If a scale of tolerance is useful to the forester, is not a scale of fire resistance more so? Can management plans, planting work, fire damage studies, and timber fire insurance, when it comes, be properly carried out if we do not know the relative resistance to fire of the trees we are to handle?

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INFLUENCE OF THE MOISTURE CONTENT OF SLASH PINE SEEDS ON GERMINATION

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THE influence of the moisture content of forest tree seeds at the time of sowing and for a period before sowing on their germination per cent and germinative energy has been studied by many investigators: Barton (1), Bates (2), Korstian (3), Larsen (4), Show (5), and Toumey (6). The seeds of many conifers have been found to retain their viability when stored with high moisture contents at low temperatures, and when stored in sealed containers with uncontrolled temperatures (1, 2, 4, 5, 6). Seeds of the oaks (3) have been stored most successfully under conditions of abundant moisture, and with the temperature just above freezing.

The results of the following tests made on seeds of slash pine (*Pinus caribaea* Morel.) indicate that the moisture content of the seeds at the time of sowing and more important for a period before sowing, has a marked influence on their germination per cent and germinative energy. Four comparable lots of slash pine seeds[1] were stored in constant relative humidity chambers for a period of two months. The relative humidity chambers[2] were made up to maintain constant relative humidities (7) of 30 per cent, 70 per cent, 90 per cent, and 100 per cent, at 21°C. After a storage period of two months in the chambers the moisture content of lot A was 7.5 per cent, lot B 11.5 per cent, lot C 22.5 per cent, and lot D 32.0 per cent, based on oven dry weight at 100°C. The seeds had a moisture content of 9.0 per cent when placed in the humidity chambers.

Two hundred and fifty seeds were taken from each sample and sowed, fifty seeds to a row, in sand flats. The remaining seeds were sealed in test tubes and stored for one year. The temperature was not controlled during the time in storage or during either of the two germination periods. Throughout both germination periods the temperature ranged from 65°F. to 85°F. During the year of storage in glass tubes the seeds were subjected to temperatures ranging from 40°F. to 80°F.

There was a long period of delayed germination for all four lots following two months storage in atmospheres of constant relative humidity. After two months storage none of the seeds of lots A and B had germinated at the end of 20 days in the sand flats, while after storage for one year at the same moisture content (7.5 per cent and 11.5 per cent) 82 per cent of lot A, and 42 per cent of lot B had germinated at the end of 20 days. Two per cent of lot C and one per cent of lot D had germinated after 20 days in the flats following two months storage. After one year's storage at variable tem-

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[1]From a collection made by Mr. P. C. Wakely of the Southern Forest Experiment Station in the fall of 1930.

[2]Saturated solutions of the following compounds were used to maintain approximately constant relative humidities at laboratory temperatures for two months: $MgCl_2.H_2O$ for 30 per cent relative humidity; NH_4Cl and KNO_3 for 70 per cent relative humidity; $Na_2SO_4.10H_2O$ for 90 per cent relative humidity and H_2O for 100 per cent relative humidity.

peratures none of the seeds of lots C and D with moisture contents of 22.5 per cent and 32.0 per cent, were viable. These two lots were heavily infected with fungi.[3] Seeds of lot C were covered with *Penicillium spp.*, *Aspergillus spp.*, and *Ospora spp.*, while the seeds of lot D were found to be covered largely with *Fusarium spp.*, and with some *Ospora spp.* No fungi were evident on seeds of lots A and B.

After one year in storage at a constant moisture content lot A finished germinating in 20 days, and lot B finished germinating in 40 days. Lot A had a germination percentage of 82 and lot B of 57 per cent. The sample of lot A germinated only 66 per cent in 300 days following two months in storage. Lots B, C, and D had germinated 72 per cent, 82 per cent, and 73 per cent respectively after 300 days in the sand flats. The flats containing the seeds that were stored for two months were sometimes allowed to dry out considerably and were then moistened again during the last 220 days in the flats. This treatment was always followed by an increase in germination.

It is apparent from these few data that slash pine seeds may be stored for a year at relatively low moisture contents and in variable temperatures without losing their viability. It is also evident that a high moisture content and variable temperatures for a year results in a loss of viability. The increased germination per cent of the seeds of high moisture content after two months storage over the germination per cent of the two seed lots of low moisture content is of no practical value because of the delayed germination.

Although these data are too limited to give positive conclusions, the influence of moisture content of seeds on germination percentage is so striking that it should suggest further study along the same line to determine the feasibility and practicability of storing seeds of this species at low moisture contents in closed containers when facilities for the maintenance of constant low temperatures are not available.

High temperatures as well as high moisture contents in seeds tend to increase the rate of respiration, which may be desirable in the case of seeds that ordinarily must go through a rest or afterripening period before they will germinate. A high respiratory rate is not desirable if the seeds are to be stored over a period of time greater than that necessary for the completion of the afterripening process.

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[3]The fungi on stored seeds were identified by Dr. F. A. Wolf of the Botany Department of Duke University.

SOME FACTORS AFFECTING THE BARK THICKNESS OF SECOND-GROWTH LONGLEAF PINE

By A. L. MACKINNEY

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The variability of bark thickness introduces errors into the measurements of diameter of forest trees. In this study of bark thickness at breast height of second growth longleaf pine variability of bark thickness between trees was found to be greater than variability on the same tree. The number of measurements necessary to get accurate estimates of bark thickness for individual trees and for diameter classes are presented. It is also shown that both annual and occasional fires reduced the bark thickness of the longleaf pines studied.

SINCE volume determinations of standing trees are commonly based on breast high measurements outside the bark and since the bark is not utilized, a knowledge of bark thickness is essential to an accurate estimate of usable volume. The bark thickness of most forest trees, however, is quite variable. To determine the amount and significance of this variability for a single species a study was made of the bark thickness of second-growth longleaf pine. The results of the study are summarized in this paper. The analysis considered: (1) the factors affecting variability of bark thickness from tree to tree, (2) factors affecting variability within individual trees and (3) the effects of annual and accidental fires on bark thickness.

Collection of Data

Three groups of permanent sample plots, located in a 35-year old second-growth longleaf pine stand at Lanes, South Carolina, were used in this study. The average stand on these plots included 80 square feet of basal area per acre in 299 trees. One group of plots has remained unburned for fourteen years, one group was unburned for ten years and was then subjected to fires burning under selected conditions every year for four consecutive years, and the other group of plots was burned over by a severe accidental fire after fourteen years' protection. Four bark thickness measurements were taken in the cardinal directions on each tree with a Swedish bark thickness measurer graduated in inches and tenths. All measurements were estimated to the nearest hundredth of an inch. Complete tree descriptions, including measurements of height and of diameter outside bark, were available for all trees. Complete data were available for 426 trees on the unburned plots, 377 trees on the annually burned plots, and 236 trees on the accidentally burned plots.

Methods of Analysis and Results

All computations were carried through on a basis of single bark thickness unless otherwise specified. This single bark thickness was determined for each tree by averaging the four measurements. In all computations diameter inside bark measurements were used. These were determined by subtracting two times the mean single bark thickness from the diameter outside bark.

Variability from Tree to Tree

Many factors may affect the variability of bark thickness from tree to tree. The most promising of these for use in this analysis were diameter and height, since data on the other factors were inadequate in most cases. In this analysis the mul-

tiple linear correlation of single bark thickness with diameter and height was computed. The resulting equation was:

Single bark thickness = .0564 diameter i.b. (inches) — .0007 height (feet) + .2543.

Here it is shown that bark thickness increases with increases in diameter, holding height constant at its mean; and bark thickness apparently decreases with increases in height, holding diameter constant at its mean. The effect of height is not statistically significant because the regression coefficient is only 0.8 as large as its standard error. The coefficient of correlation is .7684 and the standard error of estimate .1060.

When height was dropped the regression equation became:

Single bark thickness = .0537 diameter i.b. (inches) + .2322.

The correlation coefficient for this equation was .7680 and the standard error of estimate was .1060, values only slightly different from similar ones obtained for the equation including both d.i.b. and height as independent variables. This correlation coefficient indicates that 59 per cent of the variation in bark thickness is associated with variations in diameter (i.b.). The remaining 41 per cent is undoubtedly associated with other factors, including variability of bark thickness within individual trees, and mechanical error of measurement.

Variability Within Individual Trees

The bark thickness at breast height varies from place to place on the circumference of individual trees. This variability of the measurements is quite large in longleaf pine ranging from 5 to 100 per cent of the mean of four measurements. Such wide variation appears to be primarily due to the plate-like, fissured character of the bark. In addition it is undoubtedly increased by the errors in measurement. It has also been suggested that the thickness of the bark may be associated with direction of exposure, i. e., bark on the south side might be thicker than on the north side, etc.

By the "Analysis of Variance," a method devised by R. A. Fisher,[1] it was possible to break the total variability down into some of its component parts. In order to exclude the majority of the variability[2] associated with diameter the data for each of three one-inch diameter classes, the 3, 6 and 9 inch classes, were selected for analysis by this method. The variability in each of these three classes was broken down into three parts: variance between trees, variance within trees, and variance associated with error of measurement. The results of this analysis are presented in Table 1.

The most striking thing in this table is the small size of the mean square variance associated with error when compared with mean square variance between trees. This indicates that instrumental error of measurement is relatively small. It is also interesting to note that the mean square error apparently increases with diameter. Although the data available are insufficient to prove this statistically, they apparently indicate that error of measurement varies directly with thickness of bark measured.

Frequently it is desirable to get an accurate measurement of the bark thickness of an individual tree. To determine the number of measurements necessary the first step was to get the best estimate of the variance within trees, including error of measurement since this cannot be dis-

[1]Fisher, R. A. Statistical Methods for Research Workers, Third Edition. Oliver and Boyd, London, 1930. p. 216-237.

[2]All of the variability associated with diameter could be removed but for the purpose of this study the extra statistical labor did not seem justified.

TABLE 1

SUMMARY OF "ANALYSIS OF VARIANCE" OF BARK THICKNESS IN THE 3, 6, AND 9 INCH D.I.B. CLASSES

Due to	Degrees of freedom	Sum of squares	Mean squares	
		3 inch d.i.b. class		
Variation between trees	33	.857900	.0263	
Variation within trees	3	.075840	.0259	
Error of measurement	99	.619785	.0063	
Total	135	1.553525	.0115 (σ_T)[1]	No. of trees—34
		6 inch d.i.b. class		
Variation between trees	49	3.142700	.0641	
Variation within trees	3	.020578	.0069	
Error of measurement	147	1.688272	.0115	
Total	199	4.851550	.0244	No. of trees—50
		9 inch d.i.b. class		
Variation between trees	48	2.618900	.0546	
Variation within trees	3	.029271	.0098	
Error of measurement	144	1.952129	.0136	
Total	195	4.600300	.0236	No. of trees—49

[1]σ_T = Total variance, i.e., squared standard deviation of entire sample.

regarded. This can be done by adding the sum of the squares associated with variability within trees and with error and dividing this sum by the total degrees of freedom for these two classes. After setting up a desirable degree of accuracy, ±.05 inch or ±.1 inch double bark thickness 99 times out of 100 in this case, values from Table 1 can be substituted in the formula, $\sigma^2_M = \sigma^2/N$ when σ^2_M is the squared standard error of the mean, which is in each case solved for N — the number of measurements necessary. Following this procedure the following numbers of measurements were obtained:

3 inch (d.i.b.) class—11
6 inch (d.i.b.) class—18
9 inch (d.i.b.) class—22

The increasing number of measurements necessary in the larger diameter classes probably is due mainly to the increase of variance associated with error of measurement with diameter.

In order to find out how many measurements are necessary to get mean bark thickness for a diameter class with a desired degree of accuracy, the formula $\sigma^2_M = \sigma_T^2/N$ was used. Table 2 lists the values which were determined for the three diameter classes for different degrees of desired accuracy.

In these computations each of the four measurements on each tree was treated as a measurement from an individual tree. Practically the same results were obtained by using only one measurement from a tree. The results were also checked using outside bark diameter classes.

TABLE 2

NUMBER OF MEASUREMENTS NECESSARY FOR MEAN DOUBLE BARK THICKNESS OF DIFFERENT DEGREES OF ACCURACY

Desired accuracy[1]	Number of measurements[2] 3 inch d.i.b. class	6 inch d.i.b. class	9 inch d.i.b. class
.2	5	10	9
.1	18	39	38
.05	74	156	151
.025	294	625	604

[1]Desired accuracy is the ± limits from true mean double bark thickness within which the measured bark thickness will lie 99 times out of 100.

[2]Number of measurements of single bark thickness necessary in a diameter class to give desired accuracy.

It has frequently been suggested that the exposure of the bark, i. e., the direction in which the measurement is taken, has an effect on bark thickness. Accordingly the data for the same three diameter classes used in the previous computations were analyzed with this in mind. In this analysis the mean bark thickness for each cardinal direction for each diameter class was compared with the other means in the light of their standard errors, using the formula:

$$t = \frac{(\bar{X}_1 - \bar{X}_2)}{S\sqrt{1/N_1 + 1/N_2}}$$

in which t = difference ÷ standard error of the difference

$\bar{X}_1$ = Mean bark thickness of one direction

$\bar{X}_2$ = Mean bark thickness of another direction

S = Standard deviation of the composite population computed as

$$\sqrt{\frac{\Sigma(X_1 - \bar{X}_1)^2 + \Sigma(X_2 - \bar{X}_2)^2}{(N_1 - 1) + (N_2 - 1)}}$$

N_1 = No. of items going to make up $\bar{X}$.

In only 2 of the 18 comparisons was the difference between the single bark thickness for any two directions greater than 2.0 times its standard error. Since these two comparisons did not involve the same combination of directions and since the differences were only 2.10 and 2.08 times as large as their standard errors, it appears logical to assume that in this stand direction had little effect on bark thickness.

Effects of Fire

The data gathered in this study allowed the comparison of bark thickness on trees which had not been subjected to any fire for 14 years, with that on trees which had been protected for 10 years and then were subjected to fire burning under selected conditions at yearly intervals for 4 years, and on trees which were subjected to a severe accidental fire after 14 years' protection. It was impossible to make a direct comparison of the mean bark thickness of trees in each of the three groups because the mean diameters of the three groups varied. Accordingly it appeared desirable to determine whether the mean single bark thickness of trees in the same diameter (i.b.) class varied significantly between the three conditions. The 3, 6 and 9 inch diameter (i.b.) classes were chosen for this analysis. The mean single bark thicknesses of trees in each class growing under the three conditions were determined and compared in the light of their standard errors. The results (see Table 3) show that the mean bark thickness of all classes was consistently less on the annually burned trees than on the unburned trees, while the trees subjected to an accidental fire consistently showed thinner barks than either of the other two groups. As-

TABLE 3

COMPARISON OF BARK THICKNESS OF TREES IN THREE DIAMETER (I.B.) CLASSES ON UNBURNED, ANNUALLY BURNED FOR FOUR YEARS AND ACCIDENTALLY BURNED PLOTS

	Annually burned—unburned				Accidentally burned—unburned			
Diameter (i.b.) class	Mean difference in single bark thickness	σ diff[1]	t	P[2]	Mean difference in single bark thickness	σ diff[1]	t	P[2]
3	—.039	.0154	2.53	.011	—.084	.0162	5.19	.0000002
6	—.022	.0282	0.78	.435	—.077	.0266	2.90	.004
9	—.059	.0260	2.27	.023	—.079	.0361	2.19	.029

[1] σdiff = standard error of the difference.
[2] P = probability that difference is due to chance alone, expressed as a decimal.

suming that a difference which is likely to occur less than once in twenty times ($P = .05$) by chance alone is significant, it is evident in Table 3 that the difference was insignificant in only one of the diameter classes. From this the generalization can be made that fire, particularly a hard fire, occurring after a period of protection, causes an immediate reduction in bark thickness of second-growth longleaf pine.

The linear correlations of single bark thickness with diameter inside bark were computed for each group. The statistical measures are summarized in Table 4. Here it is apparent that the regression coefficients of d.i.b. are approximately the same in each equation, indicating that the increase in bark thickness with unit increases in diameter had not been appreciably changed by the fires. The main difference is between the values of the Y intercept for the three correlations. This indicates a constant reduction in bark thickness regardless of diameter class.

Summary

Four bark thickness measurements were taken at breast height in the cardinal directions on 426 longleaf pine trees which had not been subjected to fire for 14 years, on 377 trees which were subjected to 4 annual burns after 10 years' protection, and on 236 trees which were on an area burned over by an accidental fire after 14 years' protection.

The analysis of the data taken on the trees which had not been subjected to fire for 14 years indicated that height had little effect on bark thickness and diameter was quite highly correlated with bark thickness. Fifty-nine per cent of the variations in bark thickness were associated with variations in diameter. The major part of the variability in bark thickness within a diameter class appeared to be due to the variability between different trees. The variability associated with error of measurement was found to be quite small but in most cases larger than the variations of measured bark thickness at different points on the circumference of individual trees. It was found that in stands similar to the one studied 11, 18 and 22 measurements per tree were necessary to give an accuracy of ±.1 inch in double bark thickness 99 times out of 100 on 3, 6 and 9 inch trees respectively.

The number of measurements necessary to get the mean bark thickness of trees in a diameter class varies with the degree of accuracy desired. In order to get mean double bark thickness accurate to ±.1 inch 99 times out of 100 it was found that a single bark thickness measurement must be taken on 74 three-inch trees, 156 six-inch, and 151 nine-inch trees.

Both the accidental and annual fires apparently reduced bark thickness. The annual fires reduced double bark thickness approximately .1 inch, while the accidental fire reduced it about .2 inch in all diameter classes. This reduction of bark thickness by fire, while apparently quite small, must be considered as introducing a bias in cruises of burned-over longleaf pine stands.

Table 4

Summary of correlations of bark thickness with diameter inside bark for trees subjected to no fire for fourteen years, to annual fires for four years, and to accidental fire after fourteen years protection

Statistical measures	Unburned	Annually burned	Accidentally burned
Regression coefficient	0.537	.0530	.0523
Y intercept	.2322	.1985	.1462
Coefficient of correlation	.768	.816	.869
Standard error of estimate	.106	.098	.065

IDLE LAND PROBLEMS IN PENNSYLVANIA

By DR. E. A. ZIEGLER

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Pennsylvania is second only to New York in its policy of acquiring forest land. It is in the front rank of all states in developing the forest lands acquired. This timely stock taking of what is happening to the private ownership of its generally cut-over forest land and low grade farm land indicates the advisability of further expansion of state acquisition and reforestation to check the increasing tide of abandonment for taxes of low grade farm and forest land. Taxation studies referred to indicate the private reforestation and forest ownership may be bolstered by slight amendment and advertisement of the "Auxiliary Forest" yield tax law; by the reduction of the general forest property tax by 25 to 30 per cent through the state financing of the remaining local public roads (largely done in 1933); and by equalizing farm and forest assessments with residence and business property assessments.

LAND is the basic resource of civilization. Its recurring crops furnish food, clothing, and much of our shelter and warmth without which the human race would perish. Any long range view of human progress must recognize that with the inevitable failure of our mineral fuels (gas, oil, and coal), for heat and power, be it in fifty years for gas and oil, or 150 years or more for coal, the human importance of agricultural and forest soils producing vegetable carbons will much increase.

Forsooth because the Pacific timber hoard will last fifty years, and you can grow a slash pine 12 to 15 inches in diameter in that time, there is no great urgency to look to the proper reforestation of our idle forest and farm lands. This is the view even of some of our foresters. It has been emphasized that our northern hardwood forests (now about ninety per cent of all in the Allegheny Region) can produce little marketable material in less than 40 to 100 year rotations. Further an examination of our volunteer second growth remnant stands reveals such an understocking, and such a lot of crippled, defective, and almost worthless species encumbering the ground that it will be only in a second rotation that we can begin to expect normal production from now badly burned forest soils. Unless we have the mental power to look beyond our present war-spent, panicky financial condition, it is useless to discuss idle land problems or plan for the future—50, 100, and 150 years hence. Because of the time element it may be emphasized at once that the idle land problems are often society's problems to be handled collectively through government agencies rather than by private land owners.

According to the Census of Agriculture, Pennsylvania increased its *improved* farm area from 8.6 million acres in 1850 to 13.4 million in 1880, kept it almost stationary from 1880 to 1900, and since 1900 has decreased it 3.6 million acres (27 per cent) to 9.6 million in 1930. Since idle lands reforest or grow up to forest scrub in time, the decrease in improved land since 1910 only, or 2.3 million acres has been accepted as now "idle." It should also be recognized that there is much land with a little grazing use, and some completely idle but still carried in going farms as "fallow" by the census, that are sub-marginal for agriculture. These are constantly augmented by the flow of improved farm land into abandonment, shown to be 108 thousand acres per year from 1925 to 1930 by the Census. Differences in definition of

"improved farm" land, expansion of cities into farm lands, and other factors will be noted as entering the question, but allowing a proper discount for them, there is little change in the conclusions to be drawn as to the size of the problem of "idle lands."

Survey

To verify the present status of these lands a rapid survey was undertaken of some 17 of the state's 67 counties. Each township and township assessor was visited and idle lands were tabulated as identified by the assessor on his books. Complete idle farms still known as "farms" with buildings were easy to identify, but lands abandoned 10 to 20 years, with buildings gone, were often beyond the recognition of the present assessor as idle farm lands, and this is also true of lands no longer farmed but still attacched to farms—say one or two back fields on the poorest soils. The surveying member therefore had to inquire of other well acquainted residents, and do some ocular estimating.

The survey was charged with finding how much of the idle land could be assembled in 500 acre blocks, and how much was near enough to present state forest lands for administration at no added expense. The survey rejected all lands as idle that showed a maintained fence and even the most attenuated grazing. While all townships were traversed, not all lands could be examined, and the survey listed just about half the lands (232,000 acres) indicated as probably idle by the census (472,000 acres) in these 17 counties. Even this reduced and ultra-conservative list applied to the state on a percentage basis showed 1,200,000 acres as having no constructive use. Of this about 14 per cent or 172,000 acres could be organized in blocks of 500 acres of cleared land or attached to existing state forests for administration. If forest and brush lands forming part of these properties were allowed to enter the 500 acre unit limit set, the area available for state management would be doubled.

Assessed values for these lands ran from $1.00 per acre minimum to $64 per acre maximum. Probably much of the land could now be purchased for $5.00 to $6.00 per acre and each year more and more can be bought for the taxes.

Tax Survey

A forest taxation survey entered into tax delinquency in seven counties during 1932. Five forest counties (Center, Clinton, Sullivan, Elk, and Potter), where the forest forms 66 to 86 per cent of the total land area, previous to 1930 had biennial tax sales of private "unseated" forest land, unredeemed for two years, totalling from 1.7 to 9.2 per cent (average of 5.7 per cent) of their unseated forest area. In 1932 tax sales (advertised) jumped to a higher range 6.7 to 29.9 per cent, averaging 19.3 per cent of the "unseated" private forest land. If the tax sales of two agricultural counties (Franklin and Crawford) be admitted to the averages, they become 4.7 per cent previous to 1930, and 16.5 per cent (advertised only) for 1932—the first real depression figures.

Granting that the five forest counties

[1]Since this paper was prepared detailed reports compiled from the books of 51 of the 67 counties indicate land tax delinquency including no delinquency later than 1931 tax year (1932 sales) as follows:

Cleared land	—sold to the county	140,000 acres
	adv. for tax sale	264,000 acres
Forest land	—sold to the county	412,000 acres
	adv. for tax sale	326,000 acres
Total		1,142,000 acres

are extreme and that the farm woodlands are not affected to the same degree, and allowing for the 2.3 million acres of government forest (total private forest 10.7 million acres) *it may nevertheless be estimated that about one million acres*[1] *of unseated forest are either now county owned or advertised for sale in 1932* (1930 taxes). 1932 and 1933 delinquent taxes will increase this total unless the depression flattens out more rapidly than now appears. It would not be surprising if 500,000 acres remained county property after these 1932 sales.

Center County had 28,469 acres of unseated land already in the hands of the county with the redemption period expired before the 1932 lands were advertised. In Elk County the county held 10,000 acres up to and including 1930 sales.

The farm lands (assessed as "seated" lands) are not in as great a financial extremity. For the above seven counties the average biennial unredeemed tax sale land was about 1.1 per cent of the area. This doubled to 2.2 per cent in the 1932 advertised sales, with some reduction certain during the two years legal redemption period. The "seated" lands and "farm" lands are not entirely identical but may be so used here for the rough picture. The 2.2 per cent advertised for sale represents an area (with some allowance for redemption) of perhaps 200,000 acres, of which probably not over 100,000 acres will fail to find private purchasers at prices required to cover delinquent taxes only. 1931 and 1932 delinquent tax lands will not appear for sale until 1933 and 1934 generally, and an increase in the above figures must be expected.

Along with the idle land problem there lies one of unequal tax burden on different classes of property, which helps to explain the greater tax delinquency of forest over farm land and of farm over residence and business property.

In Center County 196 bona fide unforced sales of residence and business property from 1925 to 1932 had an average ratio of assessed to sale value of about 29 per cent. For the same period 93 sales of farm showed a ratio of 54 per cent, and unseated forest sales based on the sale of 17,416 acres to the state, also had a ratio of 54 per cent.

In Elk County the assessment-sale ratios combined with tax rates showed taxes on sale value for business and residence property of 24 mills, farms 30 mills, and forest property (government purchases) 52 mills. It is not surprising that tax delinquency in 1930 on the three classes of property was 0.9 per cent, 3.6 per cent and 4.2 per cent respectively. The forest delinquency would probably have been much higher than 4.2 per cent except for very extensive federal and states government purchases in this country at this time. The other 6 counties[2] studied also showed farm and forest property assessed at a higher ratio to sale value than residence and business property.

Conclusions

These idle land and tax studies clearly indicate that private ownership is finding the development of much cut-over forest land, and increasing amounts of low grade farm land too difficult for it to handle. Even before 1929, tax sales show a rapidly increasing amount of each defaulting for taxes. The "Auxiliary Forest" tax act is not generally taken advantage of to reduce the advancing of annual taxes. The solution seems to lie in increased state acquisition and develop-

[2]See mimeographed "Forest Taxation in Pennsylvania—Progress Reports"—Pennsylvania Forest Research Institute, 1933, Mont Alto, Pa.

ment of forest lands, and the purchase and reforestation by the state of enough idle farm lands to give leadership to private owners of the more scattered tracts of idle farm land.

During these years of heavy financial demands on the state for unemployment relief, the state should appropriate enough at least to acquire from the tax sale lists all of the desirable land for reforestation on which the redemption period has expired. Unemployment relief funds would do the planting.

When and if the federal Reconstruction Finance Corporation liberalizes its terms so that forest projects will not have to be self-liquidating within ten years, and it permits forest project support through taxing powers for a time, state reforestation should be a self-liquidating project worthy of immediate extension to idle, tax-sale, and submarginal farm lands.

THE RELATION BETWEEN ACORN WEIGHT AND THE DEVELOPMENT OF ONE YEAR CHESTNUT OAK SEEDLINGS

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The ideas developed by the author are in harmony with investigations abroad. They are well worthy of consideration since so little work of this nature has been done in America. The influence of varying weights of acorns on the development of one year old chestnut oak seedlings was studied. Weight measurements were made on roots, shoots, and leaves of plants from various sizes of acorns, and the height of shoot and leaf area of each plant was obtained. Variations in the above showed close correlation with variations in acorn weight. Correlation coefficients were computed, which substantiated this relationship.

IT IS generally accepted among foresters that size and type of planting stock exert considerable influence on the percentage of survival and the rate of development of tree seedlings. However, comparatively little is known concerning the effect of seed characteristics on the initial development of the seedlings. Much work on the influence of seed characteristics has been done, but the investigations have been confined largely to agricultural and horticultural plants. Little work has been done with the tree species which make up our forests.

The greater number of investigations dealing with the effect of size of tree seeds on the development of the seedlings are of foreign origin. Most of the investigators have attempted to correlate size, weight, or specific gravity of seed with plant development. Nearly all have obtained positive results although there is some contradictory evidence. Most of the evidence has related to shoot height or root length, although to some extent all plant organs have been touched upon. Of the investigations showing positive correlation between seed size or weight and seedling development, the works of Eytingen (3), and Korstian (4) may be cited; the findings of Rodger (5) may be mentioned as negative evidence. Korstian has suggested the need of additional evidence along this line.

It is the purpose of the present paper to set forth the findings of an investigation dealing with the effect of acorn weight on the development of one year chestnut oak (*Quercus montana* Willd.) seedlings. The effect of variation of acorn weight on the development of roots, shoots, and leaves is discussed. The relative extent to which the various plant organs are influenced by seed weight is also considered.

Method of Procedure

The study here reported was carried out on the Headquarters Tract of the Allegheny Forest Experiment Station, near Medford, N. J.[1]

A lot of 78 acorns was used in the study and was collected from trees on the experimental area. Before planting the acorns were weighed to the nearest

[1]To Mr. O. M. Wood, Assistant Silviculturist at the Allegheny Forest Experiment Station, is due the credit for initiating this project and appreciation is expressed for helpful suggestions offered.

tenth gram. They were all planted in an identical manner on a plot measuring three by six feet, and were spaced five by five inches. This planting was done during the fall of the year.

The plot was located beneath an opening in the canopy of a relatively open stand of sprout chestnut oak. The area received no preparation except that the shrubby ground cover, consisting chiefly of *Kalmia angustifolia* and *Vaccinum* and *Gaylussacia* species, was mowed closely to the ground. The plot was trenched to a depth of four inches and was then protected by a wire covered wooden frame about twelve inches high, three inches of which were sunk beneath the ground level. It is believed that the trenching rather effectively eliminated surface root competition from the outside.

Most of the acorns germinated between the second and seventh of May, 1930. During the period of development following germination a series of height growth measurements was taken on the stems of the seedlings. These were averaged in two groups with the idea of comparing the rate of height growth of seedlings developing from light and heavy acorns, and also of determining approximately when height growth ceased. Figure 1 shows the relation between the two groups in these respects. The light weight group includes seedlings developing from

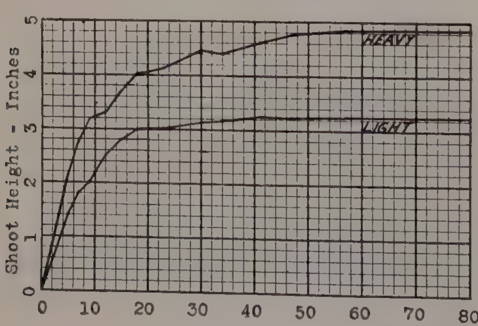

Fig. 1.—Rate of height growth. Top curve shows rate of height growth of heavy acorn seedlings; lower curve that of the light acorn seedlings.

acorns in the two to five gram classes inclusive, while the heavy group includes those in the seven to twelve gram classes. The date of initial germination was assumed to be May 3.

By reference to Figure 1 it may be seen that approximately the first fifteen to twenty days following germination constituted a period of rapid height growth. The supply of growth energy, due to the reduction of stored food material in the cotyledons, was apparently at a maximum during this period. It is also noted that the rate of height growth of seedlings developing from light weight acorns diminished rapidly after this period, while the diminution in growth rate in the heavy acorn seedlings was less rapid. The continuation of height growth in the heavy acorn group is largely a matter of greater supplies of stored food, together with the additional advantage of having larger assimilatory systems at their disposal. Seasonal height growth ceased within 55 to 60 days following germination.

Although shoot elongation had ceased by the first of July, probably diameter increment and root growth continued until a later date. By the latter part of August all growth had apparently ceased, and the seedlings were removed from the ground for further study. Extreme care was taken in removing the seedlings from the soil so that their root systems were not injured. This was readily accomplished because of the sandy nature of the soil. Figure 2 shows the general appearance of the seedlings from the two weight groups.

After the seedlings were removed from the soil, the number of leaves per plant was recorded. They were then detached and weighed collectively for each plant. The outlines of all leaves were also traced on paper and the areas were later planimetered to obtain total leaf area per plant. Each plant was then severed at the point where the cotyledons joined the

stem. Root systems and shoot were weighed separately. The length of the shoot was measured to the nearest tenth inch. For purposes of study these data were then classified according to the gram weight classes of the original acorns.

Relation of Height Growth to Acorn Weight

The ability of any plant to successfully compete with other plants is doubtless influenced by the initial impetus received at the time of development from the seed. A tree able to quickly rear its crown above those of its competitors is usually more favorably situated to hold its place in the stand than are its smaller neighbors. According to Clements, *et al* (1), an initial advantage gained by one plant over another tends to increase by cumulation and even slight increase in amount of energy or raw material is followed by corresponding increase in growth. It is generally recognized that competition decreases as dominance increases. Hence, it is believed that the height one year old seedlings are able to attain will increase noticeably the seedlings chances of future survival.

Although the data are somewhat meager, the difference in the height growth of one year old seedlings and acorn weight, indicates a distinct relationship. These results are concordant with those obtained by Nestorov, who worked with oak seedlings in Russia and whose work is reviewed by Eytingen (3). Nestorov found

Fig. 2.—Showing variation in development of one year chestnut oak seedlings from large (numbers 547-552) and small (numbers 553-558) acorns.

that increase in weight of the acorns had considerable effect on the growth of the seedlings, and that the height of the stem depended more upon acorn weight than did length of root.

Relation of Shoot and Root Weight to Acorn Weight

Root weight includes all portions of the plant below the point where the cotyledons join the stem; shoot weight includes the portions above this point, less the weight of the leaves. As in the case of the height attained by the shoot, the weight of both shoot and root system is closely correlated with acorn weight. The trend of shoot weight when plotted over acorn weight is fairly constant; the increase in weight of the largest plants over the smallest being 209 per cent. Schmidt (6), who investigated the effect of seed weight upon development of the shoots and husks of corn, found a corresponding relation. However, he found the increase in weight of the largest plants over the smallest to be only 28 per cent. In view of the fact that we are comparing mature annual plants with one year old perennials, the above difference is more readily comprehended.

The form taken by the curve of root weight is considerably different than that taken by shoot weight. In the lower weight classes the two tend to closely approximate each other, the upward trend being nearly uniform and of practically the same magnitude. However, as acorn weight increases, the effect of this factor on the weight of the root system is no longer proportional to its effect on shoot weight. Instead, the ratio of root to shoot weight becomes increasingly wider due to greatly accelerated development of roots. This is believed to be a very significant fact.

Plants developing from light weight acorns were characterized by very meager root systems, and the lack of tap roots, in all but three or four cases. The number of laterals on each of these systems was also conspicuously small. On the other hand, root systems of plants developing from heavy acorns had large tap roots which were seldom less than six inches long. Along these tap roots there were, in addition, numerous long, fibrous laterals. Considered as a group, the plants from the large acorns had far more extensive (particularly as regards depth) root systems than the plants from small acorns. In view of this fact plants in the former group would be greatly favored in competition.

Relation of Leaf Area and Weight to Acorn Weight

Since there is a close correlation between weight of shoot and root system of chestnut oak seedlings and acorn weight, it is natural to expect a similar correlation with leaves. This is shown both with respect to leaf area and weight in Table 1. With respect to leaf area, the increase between the two extreme weight

Table 1

LEAF AREA, LEAF WEIGHT, AND TOTAL PLANT WEIGHT AS RELATED TO ACORN WEIGHT

	Average group weight of acorns—grams									
	2.35	3.02	3.91	4.85	7.10	8.00	8 83	9.80	10.90	11.90
	Average area and weight values									
Leaf area, square inches	6.01	5.56	6.14	6.14	13.46	14.54	17.98	21.16	24.76	26.94
Leaf weight, grams	.42	.41	.48	.50	1.02	1.03	1.36	1.51	1.72	1.85
Total weight of plant, grams	1.56	1 58	1.87	1.85	3.51	4.19	5.27	5.67	6.63	6.16

classes is 348 per cent; leaf weight increases 340 per cent. Cummings (2), who worked with certain truck garden plants in Vermont, found that plants grown from large seed possessed more leaves of greater surface area and hence have greater assimilative capacity than plants developing from smaller seeds. In addition, it may be significant to note that in the lighter weight classes the relationship of acorn weight to both leaf area and weight is less marked than in the heavier classes. This tendency was also noted in the case of root weight. Leaf weight tended to vary more or less constantly with variation in leaf area.

Relation between Total Plant Weight and Acorn Weight

In Table 1 is shown the striking variation in total plant weight as related to acorn weight. The mean total weight of the plants in the heaviest class is shown to be 294 per cent greater than the mean of those in the lightest weight class. When total plant weight is plotted over acorn weight the curve assumes a shape very similar to that taken by root weight. This is to be expected in view of the fact that root weight constitutes more than 50 per cent of the total plant weight. Another significant point to be noted is that in the light weight classes the relationship between acorn weight and total plant weight is less pronounced than it is in the heavier classes. The data indicate that little difference could be expected in the weight of plants developing from acorns weighing less than the average for the species.

Statistical Treatment Data

In addition to the foregoing analysis, the data were treated statistically, i. e., each of the variables was correlated with acorn weight. Correlation coefficients were computed according to the method outlined by Wright (7). These, together with the standard deviations of the variables, are given in Table 3. The best correlation is shown to exist between root weight and acorn weight, and the poorest between total plant weight and acorn weight. In all cases a distinct correlation exists.

Table 2[1]

MEASUREMENTS RELATING TO THE DEVELOPMENT OF ONE YEAR CHESTNUT OAK SEEDLINGS FROM ACORNS OF VARYING WEIGHTS

Acorn weight class, grams	Number of individuals	Mean weight acorns, grams	Mean height shoot, inches	Mean weight shoot, grams	Mean weight roots, grams	Mean weight leaves, grams	Mean weight plant, grams	Mean leaf area. sq. in.
2	2	2.35	3.65	.275	.87	.42	1.56	6.01
3	16	3.02	3.71	.262	.91	.41	1.58	5.56
4	15	3.91	4.00	.351	1.04	.48	1.87	6.14
5	2	4.85	4.70	.425	.93	.50	1.85	6.14
7	2	7.10	5.60	.565	1.93	1.02	3.51	13.46
8	11	8.00	4.70	.611	2.55	1.03	4.19	14.54
9	12	8 83	5.54	.810	3.11	1.36	5.27	17.98
10	8	9.80	5.83	.690	3.46	1.51	5.67	21.16
11	2	10.90	6.35	.830	4.08	1.72	6.63	24.76
12	5	11.90	6.16	.850	3.46	1.85	6.16	26.94

[1]All data have been averaged according to gram weight classes of the original acorns.

TABLE 3

CORRELATION COEFFICIENTS AND STANDARD DEVIATIONS

Variable	Standard deviation	Correlation[1] coefficient
Acorn weight	±3.12	
Shoot height	±1.16	+.79
Leaf area	±8.67	+.81
Leaf weight	± .60	+.81
Shoot weight	± .26	+.82
Root weight	±1.25	+.85
Total plant weight	±2.49	+.71

[1]Each variable correlated with acorn weight.

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BRIEFER ARTICLES AND NOTES

The Expression of Dominance after Twenty Years in a Nursery Seed Bed

The division into diameter and crown classes resulting from an unequal rate of growth in the trees of an evenaged stand is termed an *expression of dominance.* There are several factors which govern this phenomenon in a specific stand among which the more important are the inherent characteristics of a species, the site quality, the variation in age within stands accepted as evenaged and the density of stocking as represented by the number of trees per acre. The author (1) has found that white pine (*Pinus strobus* L.) possesses the inherent characteristics requisite for an acceptable expression of dominance and that dominance is expressed unless at least two of the other factors involved are unfavorable. With two or more of the other factors unfavorable, dominance may or may not be expressed depending on the magnitude of the effect of the unfavorable factors.

Several seed beds of white pine in a nursery abandoned about 18 years ago offered an interesting opportunity for further study of an expression of dominance in this species because of the high density of stocking at the start and because the variation in age is reduced to zero. The high density of stocking and the minimum age variation both operate against an acceptable expression of dominance. The question in connection with an abandoned seed bed of white pine is, will the high site quality commonly found in a nursery outweigh the unfavorable elements in the situation and through the inherent tendencies of the species, bring about an acceptable expression of dominance?

The seed beds are in a nursery established by a private timberland owner in southern New Hampshire and subsequently abandoned. They are four feet in with and approximately one hundred feet long. Data were gathered from two of the beds, one of the plots being sixty feet long and the other seventy-six feet. Table 1 was obtained from these data.

Size of plot: 12.5 milacres. Site index (at 50 years): 65. Age: 20 years. Trees per acre: live, 14,800 including 720 dominants; dead, 13,280. Standard deviation of diameter, breast high: 0.66.

Since the plot is located on a nursery site one may assume a fairly good site. This is borne out by a site index for the plot of 65.

Standard deviation of diameter, breast high, has been found by the author (1) to be an acceptable criterion of an expression of dominance in a stand, the higher the standard deviation, the more marked the expression of dominance. Sample plots in natural stands used in the study sited show standard deviations of diameter at 20 years ranging from 0.42 to 0.75 and hence the deviation of 0.66 for the present study is decidedly in the upper brackets. With a standard deviation of 0.66 at 20 years and a density of stocking of 14,800 one may safely predict that there will be a rapid natural elimination during the next decade.

The exact number of seedlings originally present is, of course, a matter of conjecture. One should, however, be within reasonable limits in assuming that the seed bed at first contained between fifty and seventy-five seedlings per square foot. On this basis the original density of stocking would have been between 2,178,000 and 3,267,000 seedlings per acre. During a period of twenty years this number has been reduced to 14,800 trees per acre. Of these only 720 are dominant and the state of vigor of a large share of the trees below the dominant crown class is quite low. Obviously natural elimination will continue at a very rapid pace as stated above.

The dominant trees are in a good state of vigor. They have well developed crowns and have taken command of the site. They are great enough in number so that individual "wolf trees" will not develop. A good stand should result.

The evidence presented by these abandoned nursery seed beds, when considered in the light of past study, indicates strongly that white pine possesses inherent characteristics which enable it to show an acceptable expression of dominance on a good site regardless of original density of stocking or lack of variation in age.

TABLE 1

	D.b.h. in inches	Height in feet	Crown depth in feet	Crown spread in feet
Average of plot	1.0	11	3	2
Average of dominant trees	2.4	18	10	5
Average of dead trees	0.8	6		....

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TELLING FORESTRY TO THE PEOPLE

On attending a recent technical talk to foresters, on game management, the thought occurred to me: "In what way can this message be made to reach the greatest number of interested people? Here are gathered fifty persons, all somewhat familiar with the points brought out. If the talk be printed verbatim in a technical magazine, true, it will clarify the ideas of other foresters and make the details a matter of record. But what is most needed is to get this story in an interesting way to the general public who own rough woodlands or enjoy nature and wild life. Most of this public neither attend such meetings nor read technical forestry journals; but they do read their daily paper; and, as editors do not print articles their public will not read, why not write this story in a way acceptable to the editor of such a paper?"

On writing the article out then in newspaper style (tying it to current events and thought; bringing out the dramatic; and opening it up with the customary Who? What? When? and Where?) I was delighted to have the editor of the daily I read assign it important spacing at once. Moreover, that night a woodland owner to whom I was casually introduced as a local forester said: "Now I noticed in today's paper about the meeting of you foresters and was interested in . . ." And in the following discussion the adherents of game-forestry had been enlarged by several of the group present.

Without that newspaper article, the game manager's talk would have partly missed fire. So, in spite of the lessons we have learned in publicity during the New Deal,

as foresters we must still be careful not simply to repeat our story amongst ourselves. What we need to put and keep forestry across is to *"Tell Our Story to the People."*

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THE APPROACH OF UNDERSTOCKED STANDS TO NORMALITY

The approach of understocked stands to normality has been a long mooted question. Do they approach or do they not? Most of us believe that they do, but we do not know just what is the rate of this approach. Yet, unless we find out something about this approach, we will always feel reluctant to apply our normal yield tables to actual stands.

Europe has seemingly passed through this worrying stage. The latest yield tables of Prof. E. Gehrhardt[1] show in the introduction these two formulae:

$$Z_r = bZ\,(2 - b)$$
$$Z_r = bZ\,(1.7 - 0.7\,b)$$

Here "Z_r" is the periodic growth of the stand for the next decade, the density of stocking of which is "b." The value of normal periodic growth "Z" is obtained from the yield tables. The first expression is derived for tolerant species such as spruce, fir and beech. The second expression applies to intolerant pine and oak. Thus, for example, if for a given site and age a yield table for pine shows a periodic annual growth of 100 cubic feet per acre, and if the actual stand is 70 per cent stocked by volume, then the periodic growth of this stand will be $.7 \times 100\ (1.7 - .7 \times .7)$, or about 85 cubic feet. The approach to normality, as we understand it, is clearly indicated here. We would have called this periodic growth $.7 \times 100$, or 70 cubic feet, under the assumption that the growth rate of understocked stands is directly proportional to the density of stocking.

Prof. Gehrhardt has derived these formulae from the relationships determined from a comprehensive research of Messrs. Zetsche and Sommer. Zetsche, working with tolerant species, has found that the growth per cent of understocked stands is higher than the growth per cent of normal stands. His relationship reads as follows:

$$p_1 = p\left(\frac{M - M_1}{M} + 1\right)$$

In this equation p_1 and p, M_1 and M, are the growth per cents and volumes of understocked and normal stands, respectively. This equation has been transformed by Gehrhardt into the form $Z_r = bZ\,(2 - b)$, by equating the values P_1, p, and b to $\frac{100\,Z_1}{M_1}$, $\frac{100\,Z}{M}$ and $\frac{M_1}{M}$, respectively.

Looking over the periodic growth formulæ, one will notice that with the tolerant species the approach to normality of understocked stands is more rapid than in the case of other species. This is entirely logical since it is a recognized fact that tolerant species respond better to opening up of the stand. The application of these formulæ to actual stands is very simple—it requires only the knowledge of the density of stocking. In our practice, of course, we can not accept these formulæ, as they stand, without first proving their applicability to our conditions of growth. This task, however, may not prove to be an easy one, but there is no doubt that the knowledge of how to fill the gap which exists between the understocked and normal stands will be of great value in our numerous growth

[1]Gehrhardt, E. Ertragstafeln für reine und gleichartige Hochwaldbestände von Eiche, Buche, Tanne, Fichte, Kiefer, grüner Douglasie und Lärche. 2. Aufl. Berlin, 1930. 73 pg. Lwd. 5.80.

problems. At any rate, Prof. Gehrhardt's book shows how this problem can be approached.

S. R. Gevorkiantz,
Lake States Forest Exp. Sta.

Rodents and Water Supply

The part rodents play in soil making, in the storage of water and in the control of erosion is well set forth in the following extract from an article by Joseph Grinnell, entitled *Native California Rodents in Relation to Water Supply*, and appearing in the *Journal of Mammalogy.*

"There is good observational and inferential basis for recognizing that the native rodent burrowers on our watersheds contribute to the optimum welfare of the plant cover in certain definite ways, as follows:

"(1) Weathering of the substratum is promoted by the burrow systems, which carry air and water with contained solvents to the subsoil and rock masses below. By their presence through long time, the deepening of the soil is hastened.

"(2) Subsoil is comminuted and brought to the surface where, spread out thinly by action of wind and rain, it is exposed to further weathering and is incorporated with the top soil.

"(3) The activities of burrowing rodents on ground that is not overgrazed tend to prevent catastrophic erosion. During heavy storms or rapid thaws the burrows form entry ways for the water, leading it into the porous ground for further slow distribution there; and the mounds, notably those on the steeper slopes, are of such construction as to constitute veritable systems of terracing.

"(4) Much vegetable matter is carried by the rodents into their burrow systems where it contributes to form the organic content which characterizes the more productive soils. Also the surface accumulation of vegetable debris tends to be buried by the earth brought from below and this makes further for humus formation.

"(5) The burrowing activities of rodents are known in certain places to increase the supply of available nitrogen and other important chemical substances in the soil required for plant use. This effect is probably very general.

"(6) The mere mechanical loosening of the ground through the activities of burrowing animals makes for thrifty plant growth. Their presence helps to compensate for the packing effect of tramping by heavy-bodied mammals. The impact of many feet on the soil, especially when the soil is wet, greatly reduces or even extinguishes herbaceous growth on such ground. One has but to look at conditions on mountain meadows within, and outside of, national parks or other areas reserved from grazing to appreciate this point.

"(7) To a considerable degree, perhaps essentially in the cases of some important cover-plants, and even forest trees, the function of seeding under the most favorable conditions for successful germination is probably performed mainly by rodents.

"It may be said, then, with considerable measure of confidence, that on wild, uncultivated lands, especially those comprised in our watersheds, the rodents are among the necessary factors in the well-being of the ground-cover, whether it be sodded grass, chaparral of one type or another, or true forest more or less approaching its climax development."

A Method for Measuring Experimental Forest Fire Temperatures

The measurement of temperatures generated by forest fires has usually been made by means of thermocouples and

potentiometers. Temperatures can be very closely approximated by this method but it involves the use of long lead wires and a complicated set-up if readings from a number of points are to be made. Where numerous temperature measurements are to be made during burning experiments, a less complicated method is desirable.

A much simpler procedure permitting any desired number of determinations within acceptable temperature ranges was used to ascertain the temperatures generated during the experimental burning of a sixteen-acre plot of Appalachian hardwoods in the Bent Creek Experimental Forest, near Asheville, North Carolina. Seger cones, used extensively in measuring temperatures of furnaces, were used for the high temperatures and thin ribbons of fusible metal alloys were used for the temperatures below 600° C.

Seger cones are narrow based, triangular pyramids made of clays of different softening temperatures, ranging from 590° to 1850° C. When a cone is subjected to heat equal or greater than its softening temperature, the apex bends. Since such cones are not available for temperatures lower than 600° C., we were forced to resort to other materials for the measurement of temperatures below this point.

After experimentally cast cones and plates of metal alloys proved unsatisfactory, the plan was adopted of using thin ribbons cut from the bars of alloy approximately 10 inches long, with a shaper, a tool common in machine shops. By using a properly ground cutter, tightly rolled coils of thin alloy ribbons were readily obtained. The ribbon was approximately ⅛ inch wide and 1/100 inch thick, and the coils weighed about 1.25 grams each or 350 to the pound.

Previous to the burning of the experimental plot, Seger cones and alloy ribbons were suspended at a number of places throughout the area. A series of three cones softening at approximately 600°, 800° and 1000° C. were hung at 6 inches above the ground from wickets made of wire. Alloy ribbons melting at 100°, 200° and 400° C. were drawn into conical spirals, and a loop of copper wire passed through several turns near the middle of the spiral. Spirals of each of the 3 alloys were suspended at heights of 5, 10, 20 and 30 feet above ground from lengths of annealed iron wire thrown over convenient limbs. The identity of each spiral was insured by the number of small loops bent in the free end of the copper wire suspensor.

After subjecting the above mentioned plot to a light to medium fall burn, it was observed that in many cases the surface of the cones had a vitrified appearance but had not bent. This was taken to mean that the temperature had actually reached the softening point of the cones but had not persisted sufficiently long to cause bending. The cones are not designed to indicate temperatures of short duration and therefore were much less sensitive than the alloy ribbons.

Judged by the appearance of the cones temperatures generated near the ground were roughly as follows: Medium accumulation of leaf litter, 600°, small piles of slash, 800°, large piles of slash, 1000°. Melted or distorted alloy spirals indicated that temperatures at 5 feet above ground generally reached 200°; at 10 feet generally 100°; at 20 feet 100° occasionally, and at 30 feet, 100°C. was not reached.

The materials used are relatively inexpensive. Seger cones at a cost of 5 cents each, and the metal alloys at a cost ranging from 35 cents to $2.50 per pound, according to the melting point of the alloy, may be obtained from several of the large chemical supply houses.

If Seger cones are used in similar tests, the determination of temperatures, by means of thermocouples, necessary to cause vitrification or bending of the different cones is recommended as a preliminary step.

RALPH M. NELSON,
I. H. SIMS,
Appalachian Forest Expt. Sta.

NEW FOREST DEVASTATION LAW IN GERMANY

In view of the Rules of Forest Practice on privately owned timberlands resulting from Article X of the Lumber Code, unusual interest attaches to the German law of January 18 forbidding forest devastation, as anounced in *Der Deutsche Forstwirt* for January 26.

Over the signature of Chancellor Hitler and Minister of Agriculture Darre, this law provides that "for the maintenance of forests and to assure production of the annual wood requirements of the German people," it is forbidden:

§ 2, (a) To log off (that is, to clear cut) immature coniferous stands.

(b) To clear cut annually in any one working group ("Betriebseinheit"), more than one-twentieth of the area in forests from 10 to 50 hectares in size (24 to 120 acres); more than one-thirtieth of the area in forests from 50 to 100 hectares (120 to 240 acres); more than one-fortieth of the area in forests over 100 hectares (240 acres).

(c) As immature are rated all coniferous stands not yet 50 years old. Clear cutting includes, in the sense of this law, any cutting in a stand which is less than 50 per cent fully stocked in terms of a normal stand of the same species, age and site class.

(d) In case of doubt whether a stand is ripe for cutting, official sanction must be obtained before proceeding.

§ 5. Areas cut in contravention of this law must be reforested, in accordance with forestry principles, within two years and at the cost of the owner. This time may be extended to four years by the properly designated officials. The owner may be required to deposit the money required to pay for the reforesting of the area.

Penalties for violation of the law are drastic: fines, imprisonment for a year or both.

In the article explaining this law, the *Forstwirt* points out that it was made necessary by conscienceless forest butchers and devastators and that it holds no terrors for and works no hardships on, the owner who manages his forest in an orderly and proper manner. For such an owner it is, rather, a protection as well as a safeguard for national interests.

In § 6 of the law, provision is made for necessary exceptions such as wind catastrophes, insect calamities and fungus attack, which inevitably interfere with orderly, sustained yield management requiring clear cutting in advance of the stand's maturity.

A. B. RECKNAGEL,
Cornell University.

THE CHALLENGE OF THE TIMBER CONSERVATION CODE

Viewed broadly and unofficially, the timber conservation supplement to the Lumber Code combines an opportunity, a pledge and a mandate. As an experiment, in an era of industrial change, the long time factor in forest production may obscure the success or mistakes for a quarter century and the same time element requires a sustained effort or nothing. Temporary measures will not grow

trees, except that nature unaided has always been on the job.

The opportunity offered is two-edged. It lies in doing, within the bounds of feasibility, the things which the joint wisdom of coördinated units agree upon. It lies also in not trying to do what is impracticable or not needed. This is so self-evident that the acceptance of limitations as well as possibilities will be mile stones of progress.

There are a lot of cold, hard realities in the picture, including a worried and declining industry of large scope and influence. As aimed at and mainly affecting private timber ownership, it is necessary to weigh the provisions of Article X in relation to the whole Lumber Code. Despite many conditions that call for correction, there is no public emergency involving immediate or even future timber supply. What, then, is to be accomplished? To what ends are public agencies, private owners and foresters attempting to reach a closer working relationship? The accepted answer is the conservation of national forest resources for timber supply, watershed protection and the maintenance of forest industries. In short, it is all an evident part of the New Deal.

On these premises, common sense dictates that the first step is to know what is needed and then provide for it, by a liberal margin. This is easily said but the scope is so broad and complicated that reliable data and forecasts are lacking and opinions differ greatly as to needs and program. Even so, it seems logical, as a code or a policy, to first take the best possible care of what we have and grow our timber crops where they can be grown best. The program must be regional as to species, management and cost; national as to adequate supply from both public and private land.

The reverse logic is that it is poor economy to produce more than will be needed, to grow low grade timber in the face of the vast volume of existing inferior, unmarketable wood, to reforest idle or submarginal land that at best will remain a liability or to invest public or private funds under obviously unfavorable conditions for forest growth. The exceptions, of course, are protection and recreation forests.

One of the most delicate points now involved is how the private owner can any better afford to keep his lands productive by improved forest practice, than in the past. Despite the extent that public interest is concerned, it is fundamental that profit must be linked with private enterprise. A forest, under sustained yield, must in some way pay for the long rotation, hazards, carrying charges and other costs. Even if public ownership were the complete answer, which it is not, taxes can be paid only out of net earnings and, unless timber production can pay its way, it is a losing business for private capital and a government drain that can be justified only for the protection of minimum public needs.

These questions are in the minds of every lumberman and forester and, with the reasonable certainty that private forest lands will continue to play an important part, are pressing for solution as never before. As part of the spirit that prevails, the evident aim is to establish principles so broad and sound that the details and problems can be worked out as part of an applied policy. To achieve better forest practice, in the public interest, without ruining an industry, is the challenge of the timber conservation code.

E. A. STERLING.

TENNESSEE VALLEY AUTHORITY FORESTRY PERSONNEL

The Forestry and Soil Erosion Division of the Tennessee Valley Authority now has a personnel consisting of nineteen foresters and seven men assigned to erosion

control work in its employ. Edward C. M. Richards is Chief Forester for the TVA, and directs all the forestry and soil erosion activities of the Division. Before his appointment as Chief Forester, Richards was for many years a consulting and operating forester practicing in New England, the Central Atlantic States, and in the Southeast. The Division is divided into four major sections, each in charge of a section chief. The four sections set up are the Planting Section, the Lands Section, the Forest Operations Section, and the Section of Forest Investigations.

PLANTING SECTION

G. H. Lentz has been placed in charge of the Planting Section, with the title of Planting Chief, and has been assigned the duty of planning and supervising the erosion control and stand improvement work of the U. S. Forest Service in connection with the twenty-five TVA-CCC Camps. Prior to his assignment to this work, Lentz was Assistant Director of the Southern Forest Survey and had headquarters at New Orleans.

Richard Kilbourne, formerly Extension Forester of Maryland, holds the position of Assistant Planting Chief. He is organizing and establishing two forest nurseries, one on the nitrate plant No. 2 property at Muscle Shoals, Alabama, and another in the vicinity of Knoxville. These nurseries are being designed to have a capacity of fifteen million and forty million seedlings, respectively. The trees to be grown in these nurseries include such species as locust, short-leaf pine, Virginia pine and various hardwoods. These will be used in planting areas on which erosion control work has been, or will be carried on.

W. N. Darwin and N. S. Savage are each in charge of the stand improvement work carried on by ten camps in the Norris watershed area. They are also supervising the cutting of material for log and brush dam construction. In addition to the above foresters, there are also two soil erosion engineers, J. E. Synder and J. H. Nicholson, directing and inspecting the construction of erosion control dams for the twenty camps in the Norris Watershed. There are also three erosion rangers, R. S. Ratcliffe, I. P. Conger and C. S. Clevenger in the planting section. Max H. Faulkner and Robert W. Challen assist in the office and field at Muscle Shoals.

This section is coöperating directly with the U. S. Forest Service and the Army organization in carrying out the work of the CCC camps. There are at present 5,000 men in these camps, doing work for erosion control and forest stand improvement.

LANDS SECTION

The work of this section is in charge of Verne Rhoades, who has the title of Lands Chief.

Mr. Rhoades was Forest Supervisor of the Pisgah National Forest from 1919 to 1925. He was later in charge of the acquisition of lands in the Great Smoky Mountains National Park for the North Carolina Park Commission.

Working with Rhoades are three assistant chiefs, C. H. Burrage of North Carolina, I. C. Burroughs, formerly Assistant State Forester of Texas, and J. J. Goulden, former Assistant State Forester of Florida. There are three forest rangers assignment was to direct the TVA-CWA emergency relief erosion control work in the States of Virginia, North Carolina, Tennessee and Georgia. They will carry on this work during the life of the CWA relief program. Upon the completion of the CWA work, they will devote their time to the examination and study of lands for acquisition, regional planning and management in coöperation with the Land Commissioner of the TVA.

FOREST OPERATIONS SECTION

No section chief has as yet been assigned to the Section of Forest Operations. E. P. Morris and A. R. Spillers, both with the rank of Associate Foresters, are at present sharing in the direction of the section's activities. Morris, with the help of A. B. Hafer and W. P. Matthews, is working on the examination of lands lying above the Norris Lake area. A. R. Spillers has been placed in charge of the forest operations on the Town Forest at Norris, the new TVA town being built close to the Norris Dam. Robert Reed, B.S.F., University of Georgia, is assisting Spillers as forest guard.

FOREST INVESTIGATION SECTION

Bernard Frank, formerly with the Lake States Forest Experiment Station, has been placed in charge of the investigative work. The duties of this section will be to conduct investigations regarding various activities of the division.

The U. S. Forest Service is coöperating with the Forestry and Soil Erosion Division of the TVA and has charge of the actual field work carried on by the CCC camps. Philip Neff, Logging Engineer of Region One, was assigned to this work as Project Chief. Through his office the purchase of supplies and the selection of the camp supervisory personnel has been handled. The coöperation of the U. S. Forest Service has been of great value to the Forestry and Soil Erosion Division of the TVA, and under it the work of the CCC men has has been progressing splendidly.

A Study of Rot in Aspen on the Chippewa National Forest

In connection with timber sale work, it is often desirable to determine the net scale in a tree. This can be done in the case of conifers with a fair degree of accuracy. In the case of aspen (*Populus tremuloides*) in the Lake States, however, no relationship seems to have been established between outward appearances of a tree and the probable length of defect above and below the fruiting bodies. This study was undertaken to attempt to determine the relationship, if any, between the number, size and distribution of fruiting bodies of heartrot fungi and the extent of heartrot in the tree.

The data were obtained from one ¼ acre and four ⅛ acre plots carefully selected in different sites in the aspen stand on Sections 21 and 23, T. 147 N., R. 28 W. on the Cut Foot Sioux Ranger District of the Chippewa National Forest. An effort was made to have all the different sites represented in the plots.

As the trees were cut, each was given a number and all the data pertaining to that tree were recorded under that number. The defective logs were then cut up and the following observations were noted: the distance that the rot ran up and down from the highest and lowest fruiting bodies and whether the rot was connected between the two; and the position of all wounds and dead limbs. After the cutting, the logs were scaled.

Two important rots were found; the white wood rot (*Fomes igniarius*) and white butt rot (*Fomes applanatus*). It is with the white wood rot that this study is chiefly concerned. The white butt rot seldom extends up into the bole more than two feet.

Three stages of the white wood rot were recognized for the purpose of this study: the first corresponds to the pathologists "incipient stage." In this stage the center heartwood is only discolored by streaky black lines radiating out from the center of the log. The wood is not broken down and no deduction is made in scaling.

In the second stage, the black lines were spread much farther and the wood

at the center had begun to break down. This stage rarely justifies any deduction in the scale. If any is made, it should be the minimum amount and should include only that portion which has actually broken down.

In the third and final stage, the portion of the log covered by the rot is completely broken down. Here the full amount of deduction for defect in scaling should be made for the entire portion of the log as far as the third stage of rot extends up and down.

There are no fruiting bodies associated with the first stage. In the second stage, small, round, brownish fruiting bodies usually appear. These show no "annual rings." The third stage has larger, harder fruiting bodies usually showing "annual rings."

A total of 108 trees were cut on the five plots. The trees were classified into those having one fruiting body of *Fomes igniarius* and those having more than one. The fruiting bodies themselves were then divided into two classes; those less than 1 inch in diameter called "young" fruiting bodies and those more than 1 inch in diameter called "old" fruiting bodies.

All trees having dead limbs, wounds or any other injuries which might make the rot abnormal were discarded.

The distance which the rot extended up and down from each fruiting body was then measured and recorded. This measurement included the total distance covered by any stage of the rot; first, second or third. The results of these measurements are shown in Table 1. The figures in it have been rounded off for practical use.

It will be noted that the rot invariably extended down farther than it ran up from a fruiting body. Also that the rot extended much farther from large fruiting bodies than from small ones; and farther from several fruiting bodies than from a single one.

In addition to using the figures in Table 1 for aiding in determining the percentage of net scale in a standing aspen tree, they can be used to considerable advantage in scaling aspen logs. Very often a scaler is confronted with an aspen log which, although perfectly sound on both ends, may be a complete cull. He may determine this by the presence of fruiting bodies on the sides of the log.

TABLE 1

MEASUREMENTS OF ROT IN ASPEN

No. of fruiting bodies	Size of fruiting bodies	Extension of rot Above fruiting body	Extension of rot Below fruiting body
		feet	feet
One	Small	2	2.5
	Large	2.8	5
More than one	Small	3	3
	Large	5	5.5

After noting the size and number of fruiting bodies and their location on the log by reference to the table, he can determine quite accurately the complete length of the rot in the log. For example, if one or more large fruiting bodies accur within a foot either way of the middle of the log, the log is invariably a cull regardless of whether the minimum merchantable board is 8 feet or 4 feet.

If the fruiting body, or bodies, are small, he has assurance that the rot is only in the second stage and that the total length of the rot will be only 4½ feet or 6 feet, depending on whether one, or more than one, fruiting body occurs.

Probably the greatest limitation to the use of data such as these in timber estimating and scaling is the fact that certain trees which bear no fruiting bodies may be quite defective due to heartrot. Nevertheless, when fruiting bodies are present, their number, size and distribution do give a complete indication of the amount of defect in the tree or log.

GERALD S. HORTON AND
CLARE HENDEE,
U. S. Forest Service.

The Composition of Normal Oak Forests[1]

The recent completion of a growth and yield study of normal oak forests in Pennsylvania (3) made available considerable data on the number of species and their relative importance in these forests. The study was confined to the oak-hickory type as defined by Illick (2), and was initiated prior to the Society's type committee report (1). Analysis of data shows that at least two of the re-defined types (1) were worked with; type 49, white oak-black oak-red oak; and type 36, chestnut oak. Due to consistent variations it was found impractical to classify the field plots according to the new defined types.

In Table I are given summarized values for all plots. The ten most important species composing the oak forests are listed in order of occurrence on the 218 plots. In addition to these ten species, forty-one others were noted as occasional associates of the oaks (3).

The data show that in stands 10 years of age approximately 50 per cent of the species present are other than oaks and that the basal area of these associates is about half that of the total stand. With increasing age, basal area values for associated species drop rapidly but the comparative number of stems (3 inches d.b.h. and over) remains about the same. Analysis of the data shows that these changes are due to the dying of the less tolerant and short-lived species (note black locust and black cherry) and the more rapid growth rate of species which dominate the type.

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A. C. McIntyre,
Pennsylvania State College.

Union of American Biological Societies Appreciates Contribution

Franklin Reed, *Executive Secretary*,
Society of American Foresters,
Washington, D. C.

Dear Sir:

This will acknowledge the receipt of your check for $50.00 as a contribution from the Society of American Foresters to *Biological Abstracts*. Will you convey to the Society the appreciation of the Executive Committee of the Union in this matter.

Our negotiations for a permanent endowment of the Abstracts are in a very confidential stage but progressing as we hope. I am having a conference with Dr. Weaver in the matter on March 16 and I am hopeful in spite of the financial situation which is affecting the foundations as well as everyone else.

Sincerely,

W. C. Curtis,
President.

[1]Publication authorized by the Director of the Pennsylvania Agricultural Experiment Station, September 28, 1933, as Technical Paper No. 606.

TABLE 1

COMPOSITION OF NORMAL OAK FORESTS IN PENNSYLVANIA AT VARIOUS AGES. BASED ON 218 SAMPLE PLOTS.

Age of stand yrs.	White oak	Scarlet oak	Black oak	Red oak	Red maple	Chestnut oak	Hickory spp.	Dogwood	Black cherry	Black locust	All others	All oaks	Others	No. plots
TREES 3 INCHES AND OVER D.B.H. Per cent of stand														
10	15.1	6.0	11.2	8.3	13.0	2.3	3.5	0.3	13.2	9.0	18.1	42.9	57.1	10
20	45.7	11.8	6.5	4.8	4.1	9.3	1.8	1.4	6.2	1.4	7.0	78.0	22.0	23
30	39.1	6.6	6.0	6.1	5.0	22.0	3.3	0.5	1.2	0.2	10.0	79.6	20.4	37
40	29.8	7.4	4.2	10.8	6.8	33.5	3.2	0.3	0.2	0.2	3.6	85.7	14.3	63
50	21.5	8.9	6.1	12.3	11.5	32.3	2.4	1.6	0.1	0.1	3.2	81.0	19.0	40
60	23.5	8.3	7.1	14.2	11.6	23.4	5.4	1.1	0.0	0.3	5.1	76.5	23.5	20
70	19.2	0.8	6.2	26.3	12.7	22.8	3.1	0.3	0.3	0.0	8.3	75.3	24.7	8
80	29.5	10.6	8.4	5.5	5.5	23.5	4.1	5.5	0.0	0.5	6.9	77.4	22.6	4
90	35.1	8.3	5.7	11.3	3.2	19.1	6.0	1.3	0.5	2.3	7.2	79.5	20.5	10
100	36.1	5.7	0.1	4.1	0.8	49.2	1.6	0.0	0.0	0.0	2.4	95.1	4.9	3
BASAL AREA OF TREES 3 INCHES AND OVER D.B.H. Per cent of stand														
10	18.9	5.8	10.7	17.8	10.3	3.2	3.1	0.2	11.2	11.8	7.0	56.4	43.6	10
20	39.3	13.8	11.1	5.8	3.6	8.0	1.6	0.9	7.7	1.4	6.8	78.0	22.0	23
30	32.2	9.6	9.9	8.6	2.9	21.5	2.0	0.2	1.4	0.2	11.5	81.9	18.1	37
40	25.5	11.0	5.2	15.5	3.7	33.5	1.4	0.1	0.5	0.4	3.2	90.4	9.6	63
50	18.1	12.9	12.4	21.4	3.7	27.7	1.5	0.3	0.1	0.1	1.8	92.5	7.5	40
60	21.7	14.9	10.8	20.1	4.6	20.2	3.5	0.2	0.0	0.7	3.3	87.6	12.4	20
70	28.6	1.3	8.9	36.7	4.3	15.0	1.6	0.1	0.2	0.0	3.3	90.5	9.5	8
80	22.4	14.1	17.2	10.4	1.3	25.0	2.4	0.7	0.0	0.1	6.4	89.0	11.0	4
90	29.3	18.3	10.9	16.5	1.2	16.2	3.2	0.1	0.1	2.6	1.6	91.2	8.8	10
100	44.9	11.1	0.1	2.0	0.4	37.6	1.6	0.0	0.0	0.0	2.3	95.6	4.4	3
PER CENT OCCURRENCE ON ALL PLOTS														
	94.0	81.0	79.3	75.9	71.5	67.2	66.4	22.4	19.8	8.6	21.6	100.0	100.0	218

REVIEWS

Forestry and Sport. By N. A. Orde-Powlett. *Scottish Forestry Journal, Vol. 47, Part 2, Oct. 1933, pp. 93-107.*

It has become an annual event, as sure as the return of the swallow, for some American forestry journal to repeat the pious maxim that the forest is the home of the game, and that therefore the forester and game manager should embrace and dwell together in amity.

Seldom, however, has this annual homily contributed any specific suggestion as to what game, what forest, where, why, and how. Nor has it admitted the disturbing fact that considerable give-and-take must often precede the aforesaid embrace if it is to be genuine.

It is refreshing, therefore, to encounter a Scottish forester who asserts, with disarming frankness, that some forests are of no account for game, that some game ranges are of no account for forests, and that on properties where there is a chance for both timber and game crops, that chance has often gone begging because the two parties at interest, like Cæsar's Langobards and Helvetians, "were separated from each other by mutual fear and high mountains."

The Honorable Orde-Powlett's paper is explicit. He taxes foresters with ignoring the possibilities of game cropping in forestry operations, and gamekeepers with needlessly fearing the interposition of foresters in game operations.

On two classes of land now valuable for game he dismisses any serious possibility of afforestation: (1) the high grouse moors, because the soil is too poor for forests; (2) the rich low-lying partridge manors, because the soil is too good to be used for anything but agriculture.

He in turn eliminates game as a serious possibility in the belt of forest land subjoining the high moors, because this land is not attractive to game, though it offers the main chance for the expansion of forests.

The zone of overlap, therefore, simmers down to the low-lying hardwood "woodlots" now used as pheasant coverts under a coppice-with-standards system. Game keepers, he points out, fear that foresters will convert these coppiced hardwoods now productive of game into coniferous high forests worthless for game.

The validity of this fear depends, in the opinion of the author, on the intelligence of the give-and-take process. Conversion to larch, ash, poplar, or sycamore may actually benefit pheasants, but conversion to Douglas fir, Norway spruce, or Sitka spruce may have the opposite effect because these species become too thick for driving.

All coniferous plantations, he believes, become blanks as game range after the canopy closes. The value as game cover all lies in the young plantings. The main concession needed from foresters is the *widespread dispersion* of the annual cuttings (and hence plantings) over the forest, as distinguished from their concentration in large blocks or strips. (The reviewer might here remark that this identical issue of dispersion looms large in New England and the Lake States pine plantings, but no concessions to the game interest seem to have been so far made by foresters.)

The author likewise pleads that small "woodlots" are better for game than large ones, and that foresters can afford to concede a place in the sun for nut-bearing trees like beech (page the CCC!), and for border zones of shrubbery needed as game cover.

We in America may well ponder the fact that this entire discussion deals with game crops in *private* (not public) forests. It will be a happy day when we have enough private forestry in America to give us something to disagree about.

The paper concludes significantly: "Sport is not only a recreation . . . but (an economic) asset (to the) rural landowner. Anything which might militate against the sporting interests will receive short shrift from them; so that, if they can be convinced that good forestry, so far from harming the shooting interests, will be of inestimable benefit to them, a great step will be taken in attaining . . . the advancement of forestry in this country."

ALDO LEOPOLD,
University of Wisconsin.

Entwicklung des Holzverbrauchs in verschiedenen Staaten. (Development of Wood Consumption in Various Countries.) By Forstmeister Dr. von Monroy, Berlin. *Der Deutsche Forstwirt. Vol. 15, Nos. 96 and 98, pp. 621-623 and 633-635.*

Investigations of past trends in wood consumption are valuable for the light they may throw on possible future tendencies. They are particularly timely in a period, such as the present, when a spirit of pessimism prevails in the forest industries, and when so much is heard about a permanent decline in the use of wood. Such a study is this one made by Dr. von Monroy.

For the purpose of tracing world wood consumption our own Copeland Report (A National Plan for American Forestry) has been heavily drawn upon, and it is doubtful whether many Americans have analyzed these statistics as carefully as has Dr. von Monroy. New German material has also been added, and a comparison has been made between German and American conditions. The data are presented very clearly in graphic form which should be seen in the original to be appreciated. This review merely gives the most important observations of the author on the results of his study.

In Germany wood consumption per capita has been fairly constant since 1870. From 1900 to 1913 there was a small increase. This was followed by an insignificant decline from 1913 to 1928. Since 1928, of course, wood consumption has substantially declined on account of the financial depression. But even during the depression the consumption of wood has remained more stable than the consumption of pig-iron and much more stable than that of coal and lignite.

After presenting the more important statistics on world wood consumption from the Copeland Report, von Monroy comes to the conclusion that, in spite of the substitution of other raw materials in places, wood consumption per capita has not generally decreased. He finds most interesting the trends in Russia and in the United States. Since the inauguration of the five-year plan in Russia wood consumption has increased tremendously due to the use of wood in the industrialization process. In the United States the wood consumption per capita has gradually declined since the peak in 1906. This has been due, according to von Monroy, to the development of the country. The existence of large areas of virgin forest fostered wasteful utilization in the early days and resulted in a large per capita consumption. With destructive cutting of

the most accessible forests and the development of the coal and iron industries, which furnished substitutes for wood, the per capita consumption has declined.

The reasons for the slight sensitivity of wood consumption in Germany to fluctuations of the business cycle are as follows:

1. Wood is sold mainly in the country or in smaller cities, where crises and business cycle changes are not so apparent as in the large cities. This is especially true of firewood.

2. Consumption of wood for agricultural uses tends to be constant because in many cases farmers take the wood from their own woodlots, a practice which is little affected by market conditions.

3. The demand for plupwood is extraordinarily resistant to crises, chiefly because its use is constantly growing.

The situation in the United States is viewed as peculiar. The consumption of timber for construction purposes has decreased by 22 per cent from 1912 to 1928. But this decrease has been due principally to the 63 per cent decline in rural consumption. The following reasons are given for the decrease in rural consumption of structural timber:

1. The former wasteful use of wood in the rural districts, which has now given place to more economical practices.

2. The continual shifting of the center of agriculture from the East to the sparsely forested Middle West.

3. The general depression in agriculture.

In the cities of the United States, where the heaviest competition of other raw materials might be expected, wood has not only held its own but has increased in use. From 1912 to 1928 the consumption of wood for urban residential construction has increased by 33 per cent, while for other urban construction purposes the consumption has increased by 2 per cent.

The sustained consumption of wood, which is observed in nearly all countries, may be laid principally to the multiplicity of its uses—a versatility which is greater than in the case of any other raw material. But these use possibilities should be extended. Wood possesses more favorable mechanical properties for many purposes than does iron. From the physical standpoint, wood used in proper form is more resistant to fire and oxidation and is more sound-proof and a poorer conductor of heat than any other construction material. Other advantages are its easy workability and its beauty. Low ash content, cleanliness, and absence of sulphur are valuable properties of wood as fuel, both for heating and power purposes. Its utilization as a power fuel in gas form or in liquid form (alcohol) is necessary for all countries which, like Germany, do not possess extensive oil resources of their own. The increase in the world consumption of pulpwood by 2½ times from 1911 to 1929 shows the trend in the use of wood in this direction.

Dr. von Monroy's conclusion is that, in spite of the difficult market conditions of the present time, wood will retain its place among other raw materials on account of its many desirable technical properties. But in order to maintain this position it is essential that the further extension of the old uses for wood and the opening up of new uses be promoted more systematically and more vigorously than in the past.

Roy B. Thomson,
Forest Taxation Inquiry.

A Reconnaissance Soil Survey of a Portion of Kwangtung Province (China). By Robert L. Pendleton. *Geological Survey of China, No. 6, May, 1933.*

This report of general interest to conservationists has special interest to foresters for its attention to forest problems.

The area covered in the survey includes eastern portions of three rivers of Kwangtung province, being an area approximately 400 miles along the coast and 185 miles inland. Fenzel and Chang report 90 per cent of this as hilly and unfit for agricultural use. Rainfall varies from 1,129 mm. (40 inches) to 2,162 mm. (80 inches). Soil erosion was found to be serious in Kwangtung where the land is generally sloping, under heavy rainfall. A vast extent of treeless grassy slopes produce fuel grass. Remnants of groves about temples show that good tree growth is possible almost everywhere in the hills. Planting has been practiced in parts of the region. A surprising extent of idle land exists. Trees known to thrive in coastal regions of Kwangtung are pines, *Melia azadarach*, Eucalyptus, *Aleurites* (Tung oil) and bamboo. Eucalyptus has proved valuable for fuel and ties. Potential production of tung oil in Kwangtung is stressed.

Obstacles to afforestation require attention. Wide spread burning of the forest lands beyond temples and villages is practiced to keep the grass down, to eliminate wild animals and the hiding places of bandits. The uncultivated hill lands are by custom considered commons, or no man's land. Protection from fire is obviously sufficient under the prevailingly favorable climatic conditions to produce a forest cover, as is shown where fear of bandits depopulated a part of Luichow peninsula. Competition by dense grass growth disfavors forest plantations. To overcome this handicap, experience indicates that the growth of a leguminous shrub to eliminate the grass, enrich the soil and to serve as a nursecrop of planted trees, such as *Cunninghamia laaceolata,* would prove a feasible practice.

The text is fully illustrated with photographs of high descriptive value, which discloses to the student of forest conditions an unusually good conception of forestry problems of Kwangtung.

W. C. Lowdermilk,
Soil Erosion Service.

Zur Biologie der Douglasiennadelschütte. (The Biology of Douglas Fir Needle Cast). By J. Liese. *Zeitschrift für Forst.—und Jagdwesen, Vol. 64, November, 1932, pg. 680-693, 4 figures, 1931.*

This article should be of interest to the forestry profession because it tells of a disease—Douglas fir needle cast (*Rhabdocline pseudotsugae*)—that is relatively unknown, at least in the western part of the United States, and that seriously threatens the further propagation of our mountain form of Douglas fir in Germany, as well as in the rest of Europe.

In order to procure more definite information concerning the life history of this little-known fungus and the nature of its parasitism, Dr. Liese undertook its study in the Chorin seed provenance plantations of Douglas fir. These were established in 1914 from stock raised in the nursery beds of the Forest Academy at Eberswalde. This stock, in turn, was produced from seed obtained, upon the request of Dr. Schwappach, from the U. S. Forest Service and assembled by Dr. Zon. Nineteen geographical seed lots, representing three general climatic sources, were included as follows: 4 from Colorado and New Mexico representing the blue mountain form of the species (var. *glauca*); 8 from Montana and Idaho, representing the grey intermediate form (var. *caesia*), and 7 from Washington and California, representing the green coast form, which has proved itself a very desirable exotic for planting in Europe because of its rapid growth.

While succeeding in establishing some important facts in the biology of the fungus, Dr. Liese was more concerned with determining the relative susceptibility of the three climatic strains of the species, and the nature of any immunity or resistant qualities which these strains might possess. By means of phenological observations, he determined that relative immunity, to a large extent, depends upon late opening of the buds. While such a "periodic predisposition" to infection probably does not constitute the only factor in the variable character of response to attack it, nevertheless, is of outstanding significance from a practical standpoint.

As the result of his observations, Dr. Liese concludes that the mountain and intermediate forms of Douglas fir must be considered highly susceptible to infection by *Rhabdocline pseudotsugae.* The percentage of infection in the three Colorado lots (mountain variety) ranged between 10 per cent and 64 per cent, the latter figure representing the stock from the Holy Cross (old Sopris) forest. The Madison Forest lot (intermediate variety) was infected to the extent of 39 per cent. On the other hand, the valuable coast form has shown itself to be relatively immune. A fairly definite relationship exists between the degree of infection and the time when the buds open. The late opening forms or varieties of the species, to which the coast Douglas fir belongs, cannot be attacked, since their buds do not open during the period in which the fruiting bodies of the fungus ripen and the spores are disseminated. (While it is not specifically stated, it is assumed that only new needles are susceptible). In Chorin, June 1 constitutes approximately the latest date for infection. In the early opening forms (primarily of mountain or intermediate origin) the time of bud opening overlaps the principal infection period of the fungus. The notoriously peculiar habit of the mountain form to open its buds early has been observed in seed production studies by the Rocky Mountain Experiment Station; Douglas fir quite often antedating its local associates in this respect by a full month. While immune races are present in the intermediate variety of the species, Dr. Liese recommends that, in the future production of Douglas fir in Germany, only seed from trees of the coast form that open their buds late be employed.

Other conclusions derived from his study are to the effect that young Douglas fir trees, as well as older trees, may be attacked in Germany, insofar as these are the offspring of the mountain and intermediate forms and open their bud early. Also, infected branches, from which the needles have not been shed during the fall and winter, if removed from the trees by April, will not develop fruiting bodies and need not be burned to eliminate them as a source of hazard. However, it is pointed out that from a forestry standpoint, control measures based on the removal of infected trees are impractical, because it is usually impossible to detect the presence of the disease until a mass infection occurs. The result is that control operations, as a rule, are begun a year late. Hence, the importance of considering the problem at its very source.

Dr. Long, Senior Pathologist, of the Bureau of Plant Industry in Albuquerque, New Mexico, has offered the information that he has "no records showing that this disease has ever been reported from either Colorado or eastern New Mexico." Professor E. E. Hubert in his book, "Outline of Forest Pathology," reports an epidemic outbreak of the disease at Boulder, Montana, in 1915. Its relative non-occurrence in the native habitat of the mountain variety of Douglas fir suggests that the fungus thrives only in a humid, oceanic

climate, and that the coast variety of the species has probably developed a very definite degree of physiological and inherited immunity. A certain tendency along this line seems to be indicated in Dr. Liese's study. Not being informed as to the occurrence of the fungus on the Pacific Coast, it probably would stretch the imagination to advance the hypothesis that the late leafing habit of the coast form may bear some relation to past epidemics of this fungus, which have tended to eliminate early leafing races in the cost variety. The different habits of the coast and mountain forms present a somewhat paradoxical picture and do not seem to be attributable entirely to climatic and thermometric relationships.

Although other factors suggest themselves that might govern relative immunity, such as difference in needle structure and in needle shedding habit (one variety shedding its needles much more readily under the stimulus of initial infection than another), it is obvious that Dr. Liese has made an important contribution, not so much to our knowledge of the biology of forest fungi, as to our understanding of the relationship that exists between the physiological habits of forest trees and the occurrence of parasitic enemies.

J. Roeser, Jr.,
Rocky Mountain Exp. Sta.

SOCIETY AFFAIRS

Making the Society of American Foresters a Professional Organization

What is the Society of American Foresters? Founded in 1900, it now includes in its active and voting membership over 2,000 men divided into Juniors and Seniors and Fellows, with nonvoting grades of associate, corresponding or foreign, and honorary membership. More than half of all practicing foresters are members and there is no other society of professional grade in this field, if we except a recent organization of foresters on the Pacific Coast of which more later.

The original purpose of the Society, still stated as the object in the Constitution, is to advance the *science, practice* and *standards* of forestry in America. These are all three professional ideals. Do they at the present day constitute a clear and adequate definition of the objectives of a professional society, or is the Society content to rest upon a definition by which the emphasis is placed upon the results accomplished in the broad field of forestry, shared by such organizations as the American Forestry Association, and overlooks the relation and duties of the Society to the profession itself? It is not enough for the Society of American Foresters to work for the advancement of forestry as a general practice or popular and scientific movement or enterprise. Herein lies a confusion which has plagued the Society and its successive Councils since its origin 33 years ago. We can no longer postpone the decision as to whether this organization is in fact a professional society, or a mere loose aggregation of practicing or nonpracticing foresters and woodsmen.

In spite of the struggles of various committees in an effort to define the qualifications of the Junior grade of membership, with respect to men who have not received a professional education in a forest school approved by the Council, the question as to who among the extensive ranks of rangers, foremen and other practitioners and woodsmen are entitled to election is as far from a solution as ever and will remain so as long as the present standards prevail. This confusion is rooted in the failure of foresters to grasp the distinction between a profession and a craft. Fortunately Dr. Alfred North Whitehead of Harvard in a recent book entitled "Adventures of Ideas" has voiced this distinction so that those who run may read. It is this:

"A profession means an avocation whose activities are subjected to theoretical analysis and are modified by theoretical conclusions derived from that analysis. This analysis has regard to the purposes of the avocation and to the adoption of the activities for the attainment of those purposes. Such criticisms must be founded upon some understanding of the natures of the things involved in those activities, so that the results of action can be foreseen. Thus foresight based upon theory, and theory based upon understanding of the nature of things, are essential to a profession. Again, the purposes of a profession are not a single bundle of definite ends. There is a general purpose such as the curing of sickness, which defines medicine. But there

are a multitude of ways. There has in every case to be a selection of ends dependent partly upon intrinsic importance if attained, and partly upon practicability of attainment. It is for this reason that the practice of a profession cannot be disjointed from its theoretical understanding and vice versa. We do, however, find it necessary to specialize still further, not only within some department of that profession, but also either to a major consideration of its theory or to a major devotion to its practice. The antithesis to a profession is an avocation based upon customary activities and modified by the trial and error of individual practice. Such an avocation is a craft, or, at a lower level of individual skill it is merely a customary direction of muscular labor. The ancient civilizations were dominated by crafts. Modern life ever to a greater extent is grouping itself into professions. Thus ancient society was a coördination of crafts for the instinctive purpose of commercial life, whereas modern society is a coördination of professions.

"Without question the distinction between crafts and professions is not clear cut. In all stages of civilization crafts are shot through and through with flashes of constructive understanding, and professions are based upon inherited procedures. Nor is it true that the type of men involved are to be ranked higher in proportion to the dominance of abstract mentality in their lives. On the contrary, a due proportion of craftsmanship serves to breed the finer types. Pure mentality easily becomes trivial in its grasp of fact.

"The organization of professions by means of self-governing institutions places the problem of liberty at a new angle. For now it is the institution which claims liberty and also exercises control. Science is universal. The advancement of scholarship and of natural science transformed the professions. The culmination of science completely inverted the rôles of custom and intelligence in the older professions. By this inversion professional institutions have acquired an international life. Each such institution practices within its own nation, but its sources of life are worldwide. Thus loyalties stretch beyond sovereign states.

"Perhaps the most important function of these institutions is the supervision of standards of individual professional competence and of professional practice. For this purpose there is a complex weaving of universities and more specialized institutions. The problem of freedom comes in here. For it is not opinions which are censured, but learning and ability. Thus in the more important fields of thought, opinion is free and so are large divergencies of practice.

"The community is provided with objective information as to the sort of weight to be attached to individuals, and as to the sort of freedom of action which may safely be granted. Whatever is done can be subjected to the test of general professional opinion acting through this network of institutions. Further, even larger freedom can now be allowed to nonprofessional individuals.

"For the great professional organizations, so long as they are efficient, should be able to demonstrate the dangers of extravagant notions. In this way, when sudden action is not in question, reason has obtained an entrenchment which should be impregnable. Indeed, individual freedom, standing apart from organization, has now its indispensable rôle. For all organizations are liable to decay, and license for outside criticism is the best safeguard for the profession.

"Liberty of thought is largely dependent on the modern creation of professions."

The standards set up by the professions of medicine, law, and others demand a basic theoretical education as the undeviating requirement first for admission

to the professional societies, and second for a license to practice as a member of this profession. This is necessary for protection of the public against quacks, shysters, and charlatans, on the one hand, (those who claim, without possessing, professional efficiency) and on the other, against mere craftsmen, such as trained nurses in medicine, or, in forestry, woodsmen, who have learned how to do many things well by doing them, setting themselves up as competent on a professional plane to handle responsibilities which require theoretical as well as practical equipment.

Let it be clearly understood that relative character, ability, and excellence of performance are not the points in question. There are but few professional men who cannot easily be exceeded by any good craftsman operating in his own field of experience and dexterity. The craftsman who can saddle or shoe a horse, or who can conduct a logging operation, rightly feels superior to the forestry graduate who shows his inability in the other's field. But let us mince no words. This superiority alone does not entitle the forest ranger, the logging boss, the fire chief, or the nursery superintendent to full professional status in the Society of American Foresters, if that Society is in fact one which represents and acts as the embodiment of a true profession. To continue the present muddled policy on memberships is simply to admit that forestry has not yet been recognized by its own members as a profession in distinction from a craft. If the profession does not recognize this distinction, how much less will the public do so? Nonprofessional craftsmen in any such field as forestry or engineering should and do greatly outnumber those possessed of the broad theoretical equipment required of a professional practitioner. At present there is no practical limit to the number of such men who may be admitted to voting membership except the instinctive but uncrystallized resistance to accepting men actually without theoretical grasp of professional forestry, and the reluctance of the men themselves and their employers to press their claims and possibly get turned down. This condition cannot continue. Either we are a profession or we are not. The Central Rocky Mountain Section, composed largely of Forest Service men, and justifiably incensed at the ambiguity of the policy so far pursued, now demands a showdown by wiping out all distinctions between profession and craft and freely admitting all forest rangers regardless of theoretical background. On the other hand, the Institute of Professional Foresters recently organized at Seattle state:

"Ours is strictly a professional group. Membership is limited to graduate foresters and there are no exceptions. The Institute vigorously opposes the prostitution of the forestry profession by untrained or half-trained men who pose as foresters and who hold down jobs which graduate professional foresters should be holding. A half-trained dentist could not do this, neither could a doctor with but a couple of years' training and we cannot but feel that forestry is just as much of a profession as these and due just as much respect. It is our belief that a person engaged in forestry work who has not a forestry education is in exactly the same category as a person posing as a doctor who has had no medical or surgical education."

For these reasons, it is proposed to amend the Constitution of the Society with respect to Junior membership by excluding, in the future, from voting membership those who have not received a professional education as evidenced either by a degree from a forest school approved by the Council, or the passing of an examination given by the Society, resembling the standards required in the professional practice of law, medicine or

dentistry. Craftsmen formerly admitted to Junior grade would in the future be taken in as Affiliate members. The entrance to this grade would require the same qualifications as now admit them to Junior membership. The wording of these proposals is given below:

Article III. Section 3—Amended.—Junior members shall be graduates of a school of forestry approved by the Council. If not engaged in actual forestry work, the candidate for election to this grade must show proof of retaining an active interest in forestry.

Section 3a.—Affiliate members shall be those who have not graduated from a school of forestry approved by the Council, but who are engaged in actual forestry work and show proof of at least six years' creditable experience in forestry; provided that one semester of junior or senior work of a satisfactory character in a school of forestry approved by the Council, or one year of study in subjects preparatory to forestry shall be regarded as equivalent to a year of experience. This Section shall not be retroactive.

Section 3b.—Affiliate members may be advanced to the grade of Junior member under the procedure prescribed in Article IV, Section 1, after passing an examination the terms and conditions of which shall be prescribed by the Council, which shall show that their knowledge of the field of professional forestry is substantially equivalent to that required for Junior membership.

This does not bar the ranger or craftsman from the Society, but it does leave control in the hands of professional foresters and will clear up once and for all the present impossible condition.

In Great Britain, the Royal English Forestry Society has since 1913 given examinations and issued certificates of two classes, one for woodsmen, the other a forester's diploma. This diploma certifies that the holder is competent to accept serious responsibilities as manager on an estate. This forester's diploma is only given to graduates of the Woodsmen's School in the Forest of Dean, who after graduation have served four years in the woods. In the immensely broader field of forestry in America we have perhaps unconsciously adopted a pattern for the Society which would at once remove the instinctive protest of the craftsman against preferment of the cub forester with a degree, and clarify the problem of advancement to senior membership. The latter grade is now predicated on "achievement," or "ten years' experience in forestry, and demonstrated capacity to plan and execute important work in forestry." The minimum time required now for a candidate with a degree in forestry is four years after graduation with credit of six years for the course, and the same for a Junior member. The membership manual emphasizes the past tendency to lighten up on requirements for the Junior grade, and indicates by contrast the election to Senior grade as an honor in recognition of distinct professional ability and accomplishment, based on showing of leadership, initiative and actual achievement markedly and unquestionably above the average. Yet about half of our members are in the Senior grade. Evidently we have a brilliant profession or else there is something the matter with the average. It is extremely difficult for the Council to pass on these qualifications for Senior grade and much inequality exists. Certain worthy foresters are held back unduly while others less capable are advanced.

With the proposed stiffening of the requirements for Junior membership, and the satisfactory solution of the procedure for election of fellows, recently adopted in the Constitution, there is an opportunity to do something about this Senior grade. It is this: The four years of Junior membership should be regarded in the same light as those required by the

British Society. This is the seasoning period for the theoretically equipped forester with a college degree, in which he can demonstrate his capacity to adapt his training to his opportunities and responsibilities. At the end of that time, he may have shown that both in theory and practice he can be trusted with professional responsibility as a practicing forester. The Society by electing him to this grade can make it clear that the grade means just this and that the Junior grade does not carry with it such professional endorsement, because of the absence of experience. If after four years doubt still remains as to the professional capacity of the forester to carry the responsibilities attached to such guarantee or endorsement by the Society, he remains in the Junior grade until such time as the Society is safe in extending to him this endorsement. This does away with the present antiquated and bungling effort to set up a standard of achievement "markedly and unquestionably" above an undefined average, and will put the Society in a solid position in which it can protect the profession and the public against the threatened influx of hordes of incompetent, untrained, political and self-seeking persons who otherwise by appropriating the name of forester will indefinitely postpone the day when forestry is accepted on the same plane as the older professions, as a guarantee by the public of some sort of efficiency and reliability both in public and in private practice of forestry.

If the Society of American Foresters is to succeed as a society in advancing the science, practice and standards of forestry in this country, it must begin by defining and establishing both the profession of forestry and its own position and responsibilities in protecting, upholding and serving that profession for which it must logically continue to be the exponent and mouthpiece.

H. H. Chapman,
President.

Doings of the Executive Secretary February 11 to March 10, 1934

Two or three days were absorbed in the preparation and plans for distribution of the preprint of the report of the "Conference of Lumber and Timber Products Industries with Public Agencies on Forest Conservation" (appearing in the March issue of the Journal). The active demand has already nearly exhausted the edition of 5,000.

On February 15, I participated in the conference between Assistant Secretary of Agriculture Tugwell and the Conference Joint Committee, at which the recommendations of the Article X Conference for industry and public were discussed.

February 19 and 20 were spent in Springfield, Massachusetts at the annual meeting of the New England Section.

February 23 and 24 were spent in Harrisburg, Pennsylvania, at the annual meeting of the Allegheny Section.

On February 26 I attended the hearing before the National Recovery Administration on the proposed amendments to Articles VIII and X of the Lumber Code, which was the outcome of the Article X conferences.

On February 28, attended a hearing before the House Committee on Public Lands on the Taylor Bill (H. R. 6462) which provides for administration of the public domain and is in accordance with the principles adopted by our Council two years ago.

President Chapman was in town over March 5 and 6 and most of those two days were devoted to working out with him plans and policies for the Society for the coming year.

It goes without saying that the intervening days and hours between these several conferences and hearings were more than occupied with the routine secretarial and editorial duties, and with the receiving of visiting members from out of town. Among these were: Tom Skuce Extension Forester of West Virginia;

C. S. Chapman, Weyerhaeuser Timber Company, Tacoma, Washington; A. D. Folweiler, Assistant State Forester of Florida; Henry M. Meloney, New York City; H. W. Shawhan, State Forester of West Virginia; and A. S. Fathman, Secretary of the Railway Tie Association, St. Louis, Missouri.

FRANKLIN W. REED,
Executive Secretary.

Increase in Nominations Continues

Sections — schools — members — more power to you! Another tabulation of lists of candidates published in the October-April issues of the JOURNAL, indicates real progress. Here it is:

NOMINATIONS PUBLISHED OCTOBER-APRIL

Section	Junior members	Senior members	Honorary	Total
Allegheny	61			61
Appalachian	26			26
California	37	17		54
Central Rocky Mountain	29	6		35
Gulf States	9	4		13
Intermountain	2			2
Minnesota	19	2		21
New England	58	5		63
New York	45	1	1	47
Northern Rocky Mountain	11			11
North Pacific	5			5
Ohio Valley	19			19
Ozark	6	2		8
Southeastern	2	2		4
Southwestern	4			4
Washington		1		1
Wisconsin	14	1		15
Philippine Islands	6			6
	353	41	1	395

Report of the Committee on Stabilization of the Forest Industries

The report of the Committee on Stabilization of the Forest Industries which appeared on pages 240 to 245 of the February issue of the JOURNAL OF FORESTRY had the unanimous approval of the entire committee and in addition to the signature of the chairman should have carried the signatures of the other members. These are: Nelson C. Brown, R. E. Benedict, S. V. Fullaway, Tom Gill, J. V. Hofman, R. S. Kellogg, B. P. Kirkland, D. W. Martin, and T. D. Woodbury.

Council Approves a Division on Education in Forestry

Please refer to the report on page 371 of the March JOURNAL OF FORESTRY of the Conference on Education of Foresters held at Milwaukee on December 29, 1933.

Article XII of the Society's Constitution reads as follows:

"Subject divisions of the Society may be authorized by the Council upon the written petition of twenty (20) or more voting members of the Society engaged in the special field of forestry to which the division pertains, at least five (5) of whom shall be Senior Members or Fellows of the Society. Subject divisions shall be organized only as the Council is convinced of their need, and they shall be regulated through by-laws established by the Council."

Under Article XII the following members who were in attendance at the Milwaukee Conference signed a petition to the President and Council for the establishment of a Division on Education in Forestry: J. A. Larsen, Herbert Pulling, P. A. Herbert, F. A. Ineson, J. H. Allison, E. E. Probstfield, M. E. Deters, J. L. Deen, E. R. Martel, G. H. Collingwood, H. S. Newins, Frederick Dunlap, D. Den

Uyl, Burr N. Prentice, Frank B. Myers, Louis W. Rees, A. G. Shaw, Earle H. Clapp, Samuel N. Spring, N. L. Munster, D. M. Matthews, C. F. Korstian, D. B. Demeritt, Henry Schmitz, Robert Craig, Jr., Nelson C. Brown, L. J. Young, Charles G. Geltz, C. M. Granger, Fay Clark, H. P. Brown, E. V. Jotter, W. H. Horning, G. B. MacDonald, C. D. Howe, H. H. Chapman, S. T. Dana, Franklin Reed, Ralph S. Hosmer, Aldo Leopold, W. F. Ramsdell, Shirley W. Allen, Paul D. Kelleter.

The Council has given its unanimous approval and has asked the leaders in the movement to draft and submit to it for its approval a set of divisional by-laws. The provisional officers of this new division are S. T. Dana, Chairman, and Ralph S. Hosmer, Secretary.

SECTION NEWS

Allegheny

Report of 1934 Executive Committee

The first year of the five man Executive Committee has been a full and active year both for the Allegheny Section and the profession as a whole. During the year we have seen a member of the Society elected President of the United States and have seen him place in effect many important projects which deal with forestry and conservation. The ECW, the TVA, the CWA and the NRA which contains an important forestry clause as Article X in the Lumber Code.

As would be expected these new forestry projects have created many new forestry jobs and according to the best of available information 232 new jobs have been created in the Allegheny Section territory. The Section has materially aided in securing jobs for unemployed foresters by compiling a list of all known to be unemployed and securing their appointment in ECW work. A concerted effort to enroll these men in the Society has been in progress for the past six months and it is with satisfaction that we can report that 63 applications for membership have been approved by the Executive Committee. Fifty of these applications have been published in the Journals published since last October when the Society started a contest between Sections for new members. We are pleased to note that the Allegheny Section is in the lead in this contest. That we have maintained the same high standard as before may be seen in the fact that 11 other applications have been rejected by the Executive Committee.

The Executive Committee decided not to nominate any men for Senior Membership during the year as a special committee was appointed as a result of your action at the last annual meeting to make a study of the question of Senior Membership and will report at this meeting. If the report of this special committee is favorable to advancing all deserving Junior members we recommend that the next Executive Committee give this matter its early consideration.

A total of seven technical committees were appointed early in the year as follows: Types, Reforestation, Fires, Insects and Diseases, Forest Practices, Land Pol-

icy, and Utilization. A total of 57 men were appointed to these committees and a definite subject was assigned to each committee.

As a result of action taken at the last annual meeting of the Section a petition asking for a revision in the manner of electing members to the Council, was prepared and sent to all Sections. This petition was signed by 250 members from 14 Sections and was submitted to the Council on November 10, 1933 for action. The petition was held up by the Council for discussion at the annual meeting and has been referred to the incoming Council for action. A committee of the Council and an advisory committee appointed by the President is now engaged in preparing this matter for submission to the membership.

The question of politics in state forestry departments is becoming an increasingly acute matter. During the year the following state foresters and state forestry departments have been the subjects of political attacks: Delaware, West Virginia, Virginia, South Carolina, Tennessee, Wisconsin, and Minnesota. In Delaware a strongly backed bill was introduced into the State Senate to abolish the state forestry department. Realizing the importance of this bill your Executive Committee enlisted the aid of the national Society, The American Forestry Association, the U. S. Forest Service and the Chamber of Commerce of the United States besides writing the Governor of the State in behalf of the Section. It is with pleasure that we can report the failure of the bill.

As a result of your action at the last annual meeting your Executive Committee considered the names of a great many members of the Section as a possible candidate for the Council. As a result nominating petitions were prepared for Mr. F. W. Besley and submitted to the Nominating Committee. On October 29, 1933, a letter was sent to all members of the Section informing them of this action and advising them as to the correct method of voting. It is with great satisfaction that we can report the election of Mr. Besley to the Council for a term of four years.

The summer meeting was held on the George Washington National Forest in the vicinity of Luray, Va., on July 27, 28 and 29, 1933. The meeting was attended by 29 members and 52 guests. A smoker and an informal business meeting was held Thursday evening at the Mimslyn Hotel in Luray, Va. Friday the party visited several CCC camps and spots of interest in the forest. An informal dinner was held Friday evening when we listened to the Hon. A. W. Robertson speak on the relation of game to forestry. Saturday morning the trip continued over the beautiful Sky Line Trail in the Shenandoah National Park. Great credit for the success of the meeting must be given to Supervisor J. N. McNair and to the staff of the George Washington National Forest and to Mr. S. H. Marsh of the Shenandoah National Park.

During the year the Society created a grade of inactive membership and several applications were received for this grade. Your Executive Committee carefully considered these applications and transferred 5 men to this grade. An inactive member does not receive the JOURNAL, has not the power to vote, and may be reinstated to active membership on the payment of only the current year's dues.

The Allegheny Section was asked to be represented at the meeting of the Northeastern Lumber Manufacturers Association on December 5, to discuss the application of Article X to the northeast. Messrs. R. L. Emerick and N. T. Kessler were appointed to represent the Section.

Negotiations have been under way for a long time in an effort to hold a joint summer meeting with the New York Section. To this end a formal invitation was sent to the New York Section to hold such a meeting during the coming summer at

a mutually convenient place. At the annual meeting of the New York Section held in Albany, N. Y., on February 2, 1934, this invitation was debated and referred to their Executive Committee for action. Their Executive Committee has formally accepted the invitation of the Allegheny Section and has suggested that the meeting be held during the first week in September at some point easily accessible to New York State.

The report of the Nominating Committee, consisting of R. D. Forbes, Chairman, K. G. Seigworth and E. L. Scovell, has been sent to the members in the form of the ballot. One phase of the By-Laws relating to the election of the additional two members of the Executive Committee needs some elucidation. Should each of these positions be considered separate and two men nominated for each post or should four men be nominated for the two posts the two with the highest number of votes elected? We feel that this does not require an amendment to the By-Laws and should be settled by a vote of the Section.

The program for this meeting, which has been prepared by the Meetings Committee consisting of J. W. Keller, Chairman, W. J. Quick, and J. E. Mausteller, we believe is varied enough to meet the tastes of all and we urge that all members enter into the discussions. We feel that the committees which will report have done as good jobs as can reasonably be expected and in all cases should be continued. We also believe that all of those who have any suggestions which might improve the effectiveness of the Section or the Society should do so.

New England

SECTION MEETS AT SPRINGFIELD, MASS., FEB. 19-20, 1934

The meeting was attended by nearly 100 members and guests. The Secretary reported a net membership increase of 51 for the year, bringing the total membership to nearly 300.

H. H. Chapman reported for the Committees on Forest Policy, and Political Influences in the Civilian Conservation Corps. The Section adopted the following resolutions:

"We, the New England Section of the Society of American Foresters, assembled at Springfield, Massachusetts, desire earnestly to call the attention of the President and Congress to the extreme danger of disrupting many of the highly efficient technical agencies in the Department of Agriculture if the present policy reflected in the Appropriation Bill for 1935 is allowed to stand. Contemplated reductions of 20 per cent in the regular appropriations for the U. S. Forest Service alone will in our opinion, (1) reduce efficiency 50 per cent, (2) destroy the morale of an already overloaded personnel, (3) greatly increase the danger from forest fires, (4) eliminate provisions for proper care of forest camps and recreation, (5) discontinue the planting of trees on national forests, (6) stop the work on the national survey of forest resources and cripple the research work of the forest experiment stations.

"Furthermore, in the Bureaus of Entomology and of Plant Industry the authorizations for the control of white pine blister rust and for the investigations and control of new tree diseases, such as the Dutch elm disease and the beech bark blight among others, have been completely eliminated. Unless this work is continued under technically trained supervision, the entire value of control measures will be lost by the unchecked spread of these diseases.

"Also, the proposed 50 per cent cut in the appropriation for the Bureau of the Biological Survey will have the effect of crippling the technical force of this Bureau at the very time when an extensive

program of expansion of wildlife refuges is proposed.

"Such reduction and elimination of indispensable services is in direct and violent contravention of the announced conservation policies of the administration. The success of the President's policies must rest finally on efficient management by trained non-partisan personnel. This extremely efficient personnel, built up over several decades under Civil Service protection, is now threatened with rapid disintegration by forced transfer under emergency appropriations to temporary status, leading directly to final elimination on termination of such emergency measures.

"We hold that these radical reductions and elimination of recurring appropriations for trained technical and administrative services will cost the government in permanent loss of efficiency many times the amount saved.

"We appeal to the President, and to the members of Congress, to maintain and strengthen the human forces on whose shoulders rests the burden and responsibilities of the conservation program."

"Resolved, that the New England Section of the Society of American Foresters meeting in deliberation at Springfield, Massachusetts, acknowledging the new spirit and hope in the profession, desires to express to the President of the United States its appreciation and gratitude for the measures he has taken to advance and strengthen forestry.

"Resolved, that the Secretary be instructed to communicate this resolution to the President."

The New England Section of the Society of American Foresters, assembled at Springfield, Massachusetts, after a nationwide investigation of alleged political influences affecting appointments to supervisory positions in the Civilian Conservation Corps finds that:

(1) appointment for certain non-technical positions are now made wholly from lists submitted by political advisors,

(2) in some states all appointments must have the approval of the state political leaders in power, and

(3) this system is incompatible with the maintenance of efficiency in the Civilian Conservation Corps. It is breaking down the morale of the administrative forces, both federal and state, which made the project an outstanding success in its initial stages.

Public interest lies in the success of the President's program and not in the granting of political spoils.

We, therefore, urge a return to the non-political principles and procedure which governed appointments to supervisory positions at the outset and which have been adopted in the Tennessee Valley program.

This resolution was unanimously adopted and ordered sent to the President for his consideration.

Cook, Chairman of the Sub-committee on Encouragement of Private Forestry through Tax Relief called on Mr. R. C. Hall, who discussed certain conclusions of the Forest Taxation Inquiry. The report of the Committee on Public Education in Forestry was read by P. W. Ayres. C. R. Tillotson, U. S. District Forest Inspector, talked on the C.C.C. in the Northeast. Rathbun reported an actual shortage of trained foresters, and no work for the Committee on Employment. E. S. Bryant, for the Committee on Improvement of Composition of Stands discussed the work of the C.C.C. Lathrop reported for the Committee on Prevention and Suppression of Forest Fires. Schreeder, Connecticut Forest Service, showed, by means of a chart, a downward trend in forest fires in Connecticut over a period of years.

Following the evening banquet, President Chapman and Executive Secretary

Reed spoke on Society affairs, particularly on the proposed amendment to the Constitution providing for affiliate members. This proposal was endorsed by the members present.

E. C. Hirst presided over a lengthy discussion of the Lumber Code. Dean Graves gave an inspiring address on "The New Outlook under the Lumber Code" and was followed by C. R. Lockard, K. E. Barraclough, J. W. Sewall, R. C. Bryant and P. D. Kneeland.

At the morning session on February 20, N. W. Hosley reported for the Sub-committee on Fish and Game Management.

Dr. Perley Spaulding, chairman of the Committee on Forest Tree Diseases, discussed the work being done in the C.C.C. Camps. Dr. J. S. Boyce reported for the Sub-committee on Blister Rust Control. The report of the Committee on Forest Insect Control was read by the Secretary. The report of the Committee on Seed Certification was read by R. D. Stevens.

Additional resolutions were adopted, viz., Urging the Massachusetts legislature to enact the bill now pending for purchase of additional state forest land; recommending to the Governor of Rhode Island the adoption of a state forest acquisition policy; urging the National Forest Reservation Commission to increase the Green Mountain Purchase Unit in Vermont to 500,000 acres; recommending that the Seed Verification Service of the U. S. Bureau of Agricultural Economics include in its work the certification of forest tree seed.

The Section voted in favor of holding the next annual meeting of the Society in Washington, D. C.

Mr. R. M. Ross, of Connecticut, was elected Section Chairman; Secretary, Dr. H. J. MacAloney, was re-elected; K. E. Barraclough, New Hampshire and A. W. Hurford, Rhode Island were elected members of the Executive Council.

Northern Rocky Mountain

A special meeting of this Section was called in Missoula, February 27, to take advantage of Robert Marshall's presence and to hear him explain "A New Deal for the Indians."

Southwestern

A meeting was held in Albuquerque on February 1, at which the objectives and purposes of the Society were discussed. The question was raised as to whether, in view of the impetus given the forestry movement through President Roosevelt's recovery program, the Society should not come out with a clear cut statement of what it stands for and, if necessary, take steps to revise this statement so that it will have a broader implication.

It was proposed that a committee be appointed to prepare a list of the things it thought should be embodied in such a statement; that this be then submitted to the members of this Section for comments, and after revising sent to the parent Society for consideration.

Elections to Membership

The following men have been elected to the grade of membership indicated:

ALLEGHENY SECTION

Junior Membership

Ayres, Arthur W.
Barner, George Wagner
Brandt, Ray W.
Bryan, Milton M.
Buhrman, William T.
Davenport, Oscar Malcolm
Fry, George W.
Gerfin, Robert M.
Hench, Maynard H.
Johnson, William H.
Muller, John C.
Orth, Grover C., Jr.
Pyle, Clyde E.
Robinson, Floridon Edward
Sweitzer, Mark D.
Saunders, Ralph A.
Sechrist, William C.

APPALACHIAN SECTION

Junior Membership

Brender, Ernst Victor
Eaton, James L.
Hafer, Alvin B.
Matthews, William P.
Ross, Charles Robert
Schaeffer, George K.

CALIFORNIA SECTION

Junior Membership

Nelson, Alf Zahl
Tucker, David N.

Senior Membership

Bacon, Russell S.
Hasel, A. A.
Mendenhall, William V.

CENTRAL ROCKY MOUNTAIN SECTION

Junior Membership

Baer, Jacob Lander
Payson, Henry A.

Senior Membership

Williams, Roy L.

GULF STATES SECTION

Junior Membership

St. Dizier, A. J.
Squires, John W.

Senior Membership

Craig, Ronald B.
Durland, William D.
Gemmer, Eugene W.

MINNESOTA SECTION

Junior Membership

Dunn, M. R.
Rundgren, John A.

Senior Membership

Pimley, Anson E.

NEW ENGLAND SECTION

Junior Membership

Aschenbach, Ernst F.
Kendig, John D.

Senior Membership

Johnson, Ralph S.

NEW YORK SECTION

Junior Membership

Fegel, Arthur C.
Piersol, James L.
Robinson, Seward P.

OHIO VALLEY SECTION

Junior Membership

Agnew, Theo Winans
Bernardini, Mario

OZARK SECTION

Senior Membership

Long, James Sawyers

SOUTHEASTERN SECTION

Senior Membership

Folweiler, A. D.

SOUTHWESTERN SECTION

Junior Membership

Whitfield, Charles J.

Announcement of Candidates for Membership

The following names of candidates for membership are referred to Junior Members, Senior Members and Fellows for comment or protest. The list includes all nominations received since the publication of the list in the March Journal, without question as to eligibility. The names have not been passed upon by the Council. Important information regarding the qualifications of any candidate, which will enable the Council to take final action with a knowledge of essential facts, should be submitted to the undersigned before May 10, 1934. Statements on different men should be submitted on different sheets. Communications relating to candidates are considered by the Council as strictly confidential.

FOR ELECTION TO GRADE OF JUNIOR MEMBERSHIP

Name and Education	*Title and Address*	*Proposed by Section*
Adams, Thomas Edward Univ. of Calif., B.S.F., 1930.	Cultural Forest Foreman, U. S. F. S. Camp, N. Chatham, N. H.	New England
Allen, Herbert S. Univ. of Maine, B.S.F., 1931.	Forester, C. C. C. Camp 59-P, Lewiston, Maine.	New England
Armstrong, Vos Lewis Univ. of Maine, B.S.F., 1927.	Supt., C. C. C. Camp S-53, Princeton, Maine.	New England
Anderson, Charles J. Conn. State, B.S., 1929.	Forest Culture Foreman, C. C. C. Camp Roosevelt, Clinton, Conn.	New England
Barton, Henry Allen Univ. of Mich., B.S.F., 1931.	Camp Supt., Virgin Lake Camp, Three Lakes, Wis.	Wisconsin

Name and Education	*Title and Address*	*Proposed by Section*
Bennett, Howard D. N. Y. State, B.S.F., 1932.	Cultural Foreman, C. C. C. Camp 4, Kane, Pa.	Allegheny
Boerner, Quentin R. Univ. of Mich., B.S.F., 1932.	Cultural Foreman, McAvity Bay Camp, Deer River, Minn.	Ohio Valley
Bulkley, William Freeman Mich. State, B.S.F., 1932.	Technical Foreman, E. C. W. Camp Glennie, Glennie, Michigan.	Ohio Valley
Chase, Frank H. N. Y. State, B.S.F., 1927.	Technical Foreman, U. S. F. S., Camp 653, Clam Lake, Wis.	Wisconsin
Collins, Arthur B., Jr. Univ. of N. H., B.S., 1930; Yale, M.F., 1932.	Land Examiner, Homochitto N. F., and Mississippi Purchase Units, U. S. F. S., Brookhaven, Miss.	Gulf States
Cook, Kenneth Erastus Purdue, B.S.F., 1930.	Forestry Foreman, E. C. W., Morgan-Monroe For., Martinsville, Ind.	Ohio Valley
Corey, James E. N. Y. State, B.S.F., 1929.	Asst. Ranger, Argonne Unit, Nicolet N. F., Three Lakes, Wis.	Wisconsin
Dorman, Lester H. Pa. State, B.S.F., 1929.	Technical Foreman and Asst. Project Supt., C. C. C. Camp F-4, Kane, Pa.	Allegheny
Dowd, Clarence Michael Univ. of Maine, B.S.F., 1926.	Camp Supt., C. C. C. Camp Gale River F-3, Pierce Bridge, N. H.	New England
Frost, Stanley C. Univ. of Maine, B.S., 1930.	Cultural Foreman, Camp West River, Green Mountain N. F., Weston, Vt.	New England
Fuller, Francis S. Harvard Univ., A.B., 1911, M.F., 1912.	Dist. Ranger, Gorman Dist., White Mountain N. F., Gorham, N. H.	New England
Gage, Marvin H. N. Y. State, 1925-1929.	Technical Foreman, Camp F-12, U. S. F. S., Marengo, Wis.	Wisconsin
Gyure, B. L. N. Y. State, B. S., 1931.	Cultural Foreman, Stapp Camp, Ouachita N. F., Stapp, Okla.	Ozark
Humbert, John J. N. Y. State, B.S.F., 1932.	Technician, Junior Forester, Santa Fe N. F., Santa Fe, N. M.	Southwestern
Isett, Maynard C. Pa. State, B. S. F., 1932.	Forester, C. C. C. S-56, Elkridge, Maryland.	Allegheny
Johnson, Harold B. N. Y. State Ranger School, 1920.	C. C. C. work, Harvard Forest, Petersham, Mass.	New England
Knoblauch, Charles J. Univ. of Minn., B.S., 1931.	Technical Foreman, N. I. R. A. Camp Bena, Minn.	Minnesota
McComb, Andrew L. Pa. State, B.S.F., 1932; Iowa State, M.S., 1933.	Cultural Foreman, C. C. C. Camp 4, Kane, Pa.	Allegheny
McLaren, Robert D. N. Y. State, B. S., 1925.	Cultural Foreman, C. C. C. Camp Killkenny, Berlin, N. H.	New England
Monat, U. A. Univ. of N. H., B. S., 1930.	Forestry Foreman, C. C. C. Camp Granville-Tolland State Forest, West Granville, Mass.	New England
Nigewander, Walter Purdue, B.S.F., 1933.	Forester, E. C. W., Div. of For. State Library Bldg., Indianapolis, Ind.	Ohio Valley
Olson, A. Richard N. Y. State Ranger School, 1927.	Foreman, C. C. C., 4 Essex St., Deep River, Conn.	New England
Orienti, Paul T. Univ. of Maine, B.S.F., 1928.	Forester, C. C. C. Camp 372, Tolland Forest, E. Otis, Mass.	New England
Perry, Richard A. Conn. State, 1921-1922.	Ranger, Conn. State F. S., Pleasant Valley, Conn.	New England
Phillips, Benjamin F. N. Y. State, B.S., 1932.	Acting Forest Ranger, Nicolet N. F., Medford, Wis.	Wisconsin
Reynolds, Richard K. Univ. of Wash., B.S.F., 1932.	Technical Foreman, Inger Camp, Deer River, Minn.	Wisconsin
Robinson, Franklin C. N. Y. State, B.S.F., 1930	Asst. Ranger, Loretta Sta., Moose River Dist., Chequamegon N. F., Loretta, Wis.	Wisconsin
Sessions, Lee C. La. State, B.S.F., 1933.	Fisher Lumber Corp., Ferriday, La.	Gulf States
Settel, Sylvan N. Y. State, B.S.F., 1931; Columbia Univ., M.A., 1933.	Technical Foreman, C. C. C. Camp Mondeaux River, Westboro, Wis.	Wisconsin

Shank, Paul J. Univ. of Idaho, B.S.F., 1931.	Forest Technician, Idaho N. F., Warren, Idaho.	Intermountain
Shoeneman, Martin A. Iowa State, 3 yrs.	Foreman, C. C. C. Camp F-31-C, Buffalo, Colo.	Central Rocky Mount.
Simone, Anthony Univ. of Maine, 1925-1929.	Forester, Camp 66-A, Beartown Forest, South Lee, Mass.	New England
Smith, Charles E. Colo. Agric., 3½ yrs.	Forestry Foreman, C. C. C. Camp F-31-C, Pike N. F., Buffalo, Colo.	Central Rocky Mount.
Stadler, George S. Colo. Agric., B.S.F., 1932.	Foreman, C.C.C. Camp F-11, Harney N. F., Custer, S. D.	Central Rocky Mount.
Stearns, C. H. N. Y. State, B.S., 1926.	Technical Foreman, Beaver Camp No. 1604, E. C. W. Clam Lake, Wis.	Wisconsin
Stratton, Leland W. N. Y. State, B. S., 1932.	Technical Forester, C.C.C. Camp F-40, Munising, Mich.	Wisconsin
Sullivan, Eustis F. Univ. of Maine, B. S. F., 1932.	Forestry Foreman, C.C.C. Camp S-55, Spencer, Mass.	New England
Tausch, Louis, Jr. N. Y. State, B.S., 1932.	Technical Foreman, E.C.W., Camp F-19, Mountain, Wis.	Wisconsin
Wentworth, William H. Univ. of Maine, B.S.F., 1910.	Forester, Camp S-54, Erving, Mass.	New England
Wood, Roger V. High School.	State For. Supervisor, Bakersfield, Calif.	California

FOR ELECTION TO GRADE OF SENIOR MEMBERSHIP

Barker, Claude K. Livermore H. S. (Junior Member 1925.)	Asst. For. Supervisor, U.S.F.S., Porterville, Calif.	California
Clar, C. R. Univ. of Calif., B.S.F., 1927. (Junior member, 1928.)	Tech. Asst. State Forest Service, Sacramento, Calif.	California
Mason, Ira J. Univ. of Mich., B. S. F., 1925 (Junior member, 1926.)	Asst. Supervisor, U.S.F.S., Medford, Ore.	California
Peirce, Earl S. (Rein.) Yale, 1 yr. Forest School (Senior, 1923.)	For. Supervisor, Superior N.F., Milwaukee, Wis.	Wisconsin
Righter, F. I. Cornell, B. S., 1923; M. F., 1928. (Junior member, 1929.)	Geneticist, Inst. of Forest Genetics, Placerville, Calif.	California
Schofield, W. R. Univ. of Idaho, B. S. F., 1916. (Junior member, 1928.)	Forest Engineer and Appraiser, Board of Equalization, Sacramento, Calif.	California
Sinclair, Jesse D. Univ. of Calif., B. S. F., 1926; M.S.F., 1929. (Junior member, 1931.)	Asst. For. Ecologist, Calif. For. Exp. Sta., Berkeley, Calif.	California

C. F. KORSTIAN,
Member of Council in Charge of Admissions.

SOCIETY OFFICERS

Officers and Members of Council

President, H. H. Chapman, Yale School of Forestry, New Haven, Conn.
Vice-President, Earle H. Clapp, Forest Service, Washington, D. C.
Secretary-Treasurer, C. M. Granger, U. S. Forest Service, Washington, D. C.

Council

The Council consists of the above officers and the following members:

	Term expires		Term expires
F. W. Besley	Dec. 31, 1937	E. L. Demmon	Dec. 31, 1935
Emanuel Fritz	Dec. 31, 1937	A. F. Hawes	Dec. 31, 1935
Ward Shepard	Dec. 31, 1937	C. F. Korstian	Dec. 31, 1935
S. N. Spring	Dec. 31, 1937	Hugo Winkenwerder	Dec. 31, 1935

Member in Charge of Admissions

C. F. Korstian

Executive Offices

810 Hill Bldg., Washington, D. C.
Franklin W. Reed, *Executive Secretary*

Section Officers

Allegheny

J. M. Sloan, Chairman, Anthracite Forest Prot. Assoc., 514 Hazelton Natl. Bank Bldg., Hazelton, Pa.
A. C. McIntyre, Vice-Chairman, Dept. of Forestry, State College, Pa.
H. F. Round, Secretary, Forester's Office, Pa. R. R. Co., Philadelphia, Pa.

Appalachian

W. J. Damtoft, Chairman, Champion Fibre Co., Canton, N. C.
William Maughan, Vice-Chairman, Duke University, Durham, N. C.
I. H. Sims, Secretary, 223 Federal Bldg., Asheville, N. C.

California

George H. Cecil, Chairman, Chamber of Commerce, Los Angeles, Calif.
Jay H. Price, Vice-Chairman, U. S. Forest Service, San Francisco, Calif.
Russell Beeson, Secretary, U. S. Forest Service, San Francisco, Calif.

Central Rocky Mountain

W. J. Morrill, Chairman, 617 Remington St., Ft. Collins, Colo.
Wm. R. Kreutzer, Vice-Chairman, Box 567, U. S. Forest Service, Ft. Collins, Colo.
H. D. Cochran, Vice-Chairman, (Denver) U. S. Forest Service, Denver, Colo.
C. L. Van Giesen, Secretary-Treasurer, U. S. Forest Service, Ft. Collins, Colo.

Gulf States

P. M. Garrison, Vice-Chairman, Bogalusa, La.
Robert Moore, Secretary, University Station, Baton Rouge, La.

Intermountain

Dana Parkinson, Chairman, U. S. Forest Service, Ogden, Utah.
Charles N. Genaux, Univ. of Idaho, Southern Branch, Pocatello, Idaho.
H. N. Shank, Secretary, U. S. Forest Service, Ogden, Utah.

Minnesota

L. W. Rees, Chairman, Div. of Forestry, University Farm, St. Paul, Minn.
S. R. Gevorkiantz, Secretary-Treasurer, Lake States Forest Exp. Sta., Univ. Farm, St. Paul, Minn.

New England

R. M. Ross, Chairman, 3683 Whitney Ave., Mt. Carmel, Conn.
H. J. MacAloney, Secretary, Northeastern Forest Exp. Sta., 335 Prospect St., New Haven, Conn.

New York

H. P. Brown, Chairman, N. Y. State College of Forestry, Syracuse, N. Y.
W. M. Harlow, Secretary, N. Y. State College of Forestry, Syracuse, N. Y.

Northern Rocky Mountain

L. F. Watts, Chairman, U. S. Forest Service, Missoula, Mont.
J. E. Ryan, Vice-Chairman, U. S. Forest Service, Newport, Wash.
Geo. M. Jemison, Secretary, U. S. Forest Service, Missoula, Mont.

North Pacific

H. J. Andrews, Chairman, U. S. Forest Service, Portland, Ore.
S. A. Wilson, Secretary-Treasurer, Pac. N .W. Forest Exp. Sta., U. S. Court House, Portland, Ore.
Vice-Chairman, Oregon: S. V. Fullaway, 510 Yeon Bldg., Portland, Ore.
Vice-Chairman, Washington: C. S. Chapman, c/o Weyerhaeuser Timber Co., Tacoma, Wash.
Vice-Chairman, British Columbia: R. C. St. Clair, District Forester, Vancouver, Can.
Vice-Chairman, Hawaii: C. S. Judd, 1828 Vancouver Highway, Honolulu, Hawaii.
Vice-Chairman, Alaska: B. F. Heintzleman, U. S. Forest Service, Juneau, Alaska.

Ohio Valley

Stanley, S. Locke, 121 State Capitol, Springfield, Ill.
T. E. Shaw, Secretary-Treasurer, Purdue University, Lafayette, Ind.

Ozark

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Wilson Martin, Vice-Chairman, Highland Rim Office, Dickson, Tenn.
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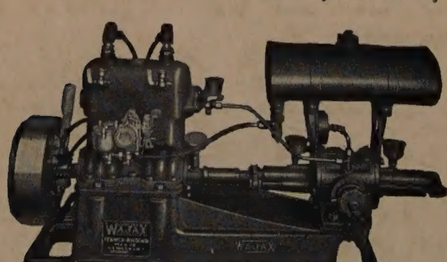

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